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NATIONAL DAM INSPECTION PROGRAM. LAKE SOPHIA DAM (NDI ID PA-007--ETC(U)
1981 DACW31-81-C-0014
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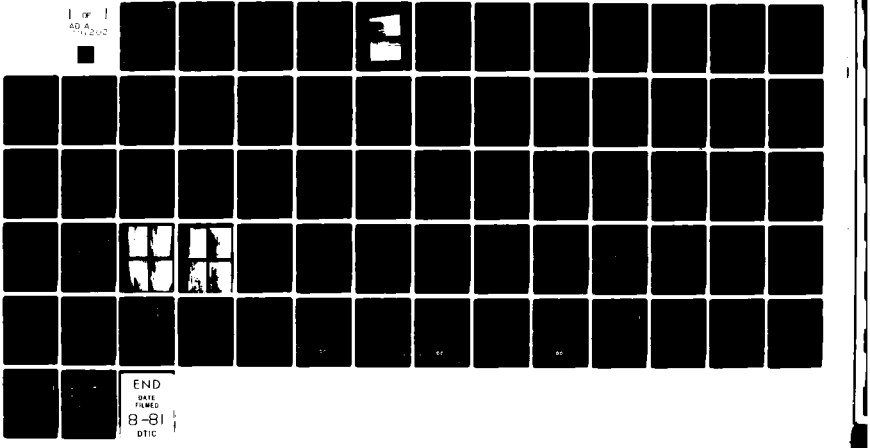

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SUSQUEHANNA RIVER BASIN
TRIBUTARY OF CHOCONUT CREEK, SUSQUEHANNA COUNTY

# PENNSYLVANIA

6 National Dam Inspection Program. Lake Sophia Dam (NDI ID PA-ØØ78, DER ID Ø58-126), Susquehanna River Basin, Tributary of Choconut Creek, Susquehanna County, Pennsylvania. Phase I Inspection Report.

# LAKE SOPHIA DAM

NDI I.D. PA-0078
DER I.D. 058-126
OWNER: MRS. SOPHIA TUROSKI

## PHASE I INSPECTION REPORT
## NATIONAL DAM INSPECTION PROGRAM

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PREPARED FOR

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, CORPS OF ENGINEERS
BALTIMORE, MARYLAND 21203

BY

D'APPOLONIA CONSULTING ENGINEERS
10 DUFF ROAD
PITTSBURGH, PA. 15235

Contract DACW31-81-C-0014

## PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Department of the Army, Office of Chief of Engineers, Washington, D.C. 20314.

The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon visual observations and review of available data. Detailed investigations and analyses involving topographic mapping, subsurface investigations, material testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the inspection is intended to identify any need for such studies which should be performed by the owner.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of the dam depends on numerous and constantly changing internal and external factors which are evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

The assessment of the conditions and recommendations was made by the consulting engineer in accordance with generally and currently accepted engineering principles and practices.





"Original contains color plates: All DTIC reproductions will be in black and white"

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

NAME OF DAM: Lake Sophia Dam
STATE LOCATED: Pennsylvania
COUNTY LOCATED: Susquehanna
STREAM: Unnamed Creek, tributary of Choconut Creek
SIZE CLASSIFICATION: Small
HAZARD CLASSIFICATION: High
OWNER: Mrs. Sophia Turoski
DATE OF INSPECTION: March 23, 1981 and April 30, 1981

ASSESSMENT: Based on the evaluation of existing conditions, the condition of Lake Sophia Dam is considered to be unsafe/nonemergency due to seriously inadequate spillway capacity.

Swampy areas were observed below the junction of the embankment and the abutments along both abutments. A seepage condition with precipitate was found to be associated with the swampy area along the right abutment toe. The outlet works discharge channel is blocked by debris. A beaver dam below the dam forms a pond that submerges the toe of the dam. Consequently, a portion of the downstream toe could not be adequately inspected for signs of seepage and concerns exist as to the effect of these conditions on the continued stability of the dam. Therefore, further investigation of the condition of the dam by a professional engineer and implementation of necessary remedial measures is recommended.

The spillway capacity was evaluated according to recommended criteria and found to be seriously inadequate. According to the recommended criteria, small dams in the high hazard category are required to pass from one-half to full Probable Maximum Flood (PMF). In view of the size and downstream damage potential, one-half PMF was selected as the spillway design flood. The flood discharge capacity was evaluated according to the recommended procedure and was found to pass approximately 15 percent of the PMF without overtopping the dam. Results of the breach analysis indicate that downstream damage would be significantly increased due to a dam failure. As a result, the flood discharge capacity of the spillway is classified to be seriously inadequate.

The following recommendations should be implemented immediately or on a continuing basis.

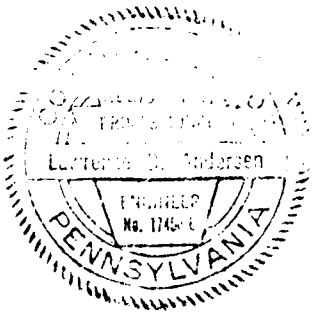
1. The owner should immediately retain a professional engineer to conduct additional studies to more accurately ascertain the spillway capacity and the nature and extent of improvements required to provide adequate spillway capacity. In the interim, the spillway weir should be immediately removed and the crest of the dam should be filled to the design level.

2. In conjunction with the above work, investigations should be undertaken to prepare and execute plans for controlling seepage along the downstream toe and for evaluating the structural integrity of the embankment in view of observed conditions.

3. The owner should confirm the operational condition of the outlet works and perform necessary maintenance, if found inoperative.

4. Around-the-clock surveillance should be provided during unusually heavy runoff and a formal warning system should be developed to alert the downstream residents in the event of an emergency.

5. The owner should develop a formal operating and maintenance plan for the dam, inspect the dam regularly and perform necessary maintenance.




Lawrence D. Andersen, P.E.
Vice President

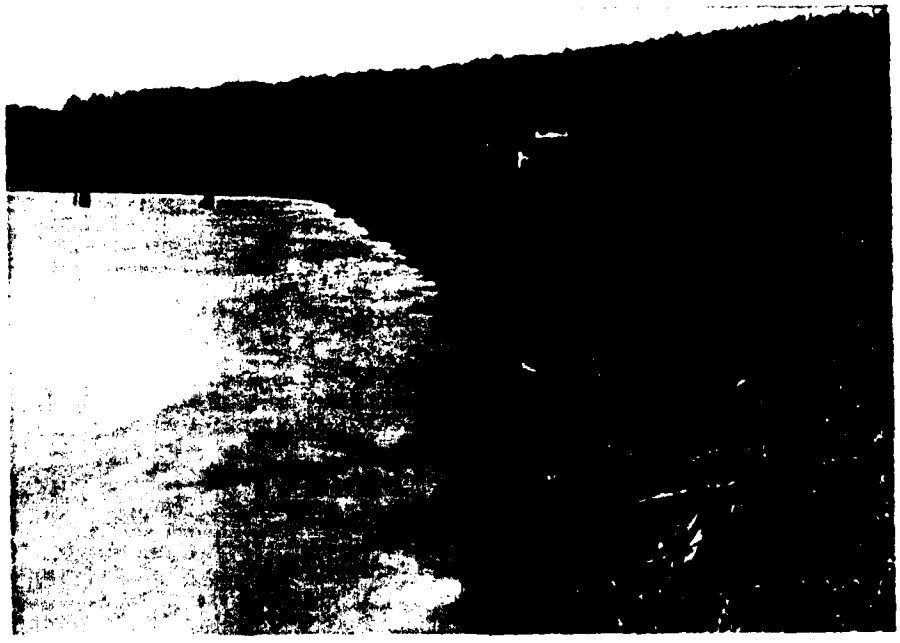
June 1, 1981
Date

Approved by:

JAMES W. PECK
Colonel, Corps of Engineers
Commander and District Engineer

17 June 1981
Date:

LAKE SOPHIA DAM
NDI I.D. PA-0078
DER I.D. 058-126
MARCH 23, 1981



Upstream Face

Downstream Face

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PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM
LAKE SOPHIA DAM
NDI I.D. PA-0078
DER I.D. 058-126

# SECTION 1
# PROJECT INFORMATION

## 1.1 General

a. Authority. The inspection was performed pursuant to the authority granted by The National Dam Inspection Act, Public Law 92-367, to the Secretary of the Army, through the Corps of Engineers, to conduct inspections of dams throughout the United States.

b. Purpose. The purpose of this inspection is to determine if the dam constitutes a hazard to human life or property.

## 1.2 Description of Project

a. Dam and Appurtenances. Lake Sophia Dam consists of an earth embankment approximately 340 feet long with a maximum height of 29 feet from the downstream toe and a crest width of 9 feet. The upstream side of the dam is protected by a small amount of riprap and the downstream face is covered with grass. The flood discharge facilities for the dam consist of a concrete open-channel spillway located near the left abutment. The spillway is a 35-foot-wide concrete rectangular channel. A one-foot-high concrete sill across the base of the spillway channel is the overflow section of the spillway. The overflow section is equipped with a 12-inch-high steel plate weir. The spillway overflow section discharges into a concrete channel and then to the plunge pool at the toe of the dam, which in turn discharges into an earth channel. The outlet facilities consist of a 12-inch-diameter corrugated metal pipe extending through the embankment along the original streambed. The flow through the outlet pipe is controlled by a sluice at the upstream end and is operated by a valve stem supported by a concrete pier extending above lake level. This outlet facility constitutes the emergency drawdown system for the reservoir.

b. Location. Lake Sophia Dam is located on an unnamed creek, a tributary of Choconut Creek in the northwestern part of Silver Lake Township, Susquehanna County, Pennsylvania (N41° 58.3', W75° 58.7'). Plate 1 illustrates the location of the dam.

c. Size Classification. Small (based on 29-foot height and 164 acre-feet storage capacity).

d. Hazard Classification. The dam is classified to be in the high hazard category. Below the dam, the unnamed creek flows about

1.4 miles to Route 267 at the Village of Choconut where the stream joins the Choconut Creek. There are three houses, one store, and one mobile home near its confluence with Choconut Creek. In the event of a dam failure, it is estimated there would be extensive economic damage in this reach and the loss of more than a few lives is considered possible.

e. Ownership. Mrs. Sophia Turoski, R.D. #1, Box 92, Brackney, Pennsylvania 18812.

f. Purpose of Dam. Recreation.

g. Design and Construction History. The dam was designed by Scandale and Associates Consulting Engineers of Scranton, Pennsylvania. Construction of the dam was completed in 1957.

h. Normal Operating Procedure. The reservoir is normally maintained at the spillway flashboard crest level (Elevation 1402, USGS Datum), leaving 2.8 feet of freeboard to the top of the dam at Elevation 1404.8. All inflow occurring when the reservoir level is at the spillway crest elevation or above is discharged over the uncontrolled spillway.

1.3 Pertinent Data. Elevations referred to in this and subsequent sections of the report were calculated based on field measurements, assuming the flashboard crest of the spillway to be at Elevation 1402 (USGS Datum), which is the elevation shown as the normal pool elevation on the USGS 7.5-minute Laurel Lake PA-NY quadrangle. Elevations shown in design drawings do not appear to be relative to USGS Datum. In the design drawings, the normal pool level is shown to be at Elevation 1467.2.

| | |
|---|---|
| a Drainage Area | 1.47 square miles[1] |
| b. Discharge at Dam Site (cfs) | |
| Maximum known flood at dam site | Unknown |
| Outlet conduit at maximum pool | Unknown |
| Gated spillway capacity at maximum pool | Not applicable |
| Ungated spillway capacity at maximum pool | 540 |
| Total spillway capacity at maximum pool | 540 |
| c. Elevation (USGS Datum) (feet) | |
| Top of dam | 1404.8 (low spot)<br>1406.0 (as designed) |
| Maximum pool | 1404.8 |
| Normal pool (with flashboard) | 1402.0 |
| Spillway crest (without flashboard) | 1401.0 |
| Upstream invert outlet works | Unknown |

[1] Drainage area planimetered from USGS topographic map is 1.4 square miles. State records indicate the drainage area to be 1.47 square miles.

| | |
|---|---|
| Downstream invert outlet works | 1375± (2) |
| Maximum tailwater | Unknown |
| Toe of dam | 1376± |

d. Reservoir Length (feet)

| | |
|---|---|
| Normal pool level | 800± |
| Maximum pool level | 1100± |

e. Storage (acre-feet)

| | |
|---|---|
| Normal pool level (with flashboard) | 120 |
| Maximum pool level (measured low point) | 164 |

f. Reservoir Surface (acres)

| | |
|---|---|
| Normal pool level (with flashboard) | 13.8 (3) |
| Maximum pool level (measured low point) | 19.1 |

g. Dam

| | |
|---|---|
| Type | Earth embankment |
| Length | 340 feet |
| Height | 29 feet |
| Top width | 9 feet |
| Side slopes | Downstream: 2.5H:1V (as designed), 2.0H:1V (as measured); Upstream: Not determinable |
| Zoning | Yes |
| Impervious core | Yes |
| Cutoff | Yes |
| Grout curtain | No |

h. Regulating Outlet

| | |
|---|---|
| Type | 12-inch-diameter corrugated metal pipe |
| Length | 130± feet (measured from design drawings) |
| Closure | 12-inch gate valve |
| Access | By boat |
| Regulating facilities | Upstream valve |

(2) Downstream end of the pipe could not be located. Elevation is estimated.

(3) Planimetered from USGS topographic map. Design drawing indicates the lake area at EL. 1401 to be 6.5 acres (without flashboard) or 10.0 acres at top of dam El. 1406.

i. Spillway

| | |
|---|---|
| Type | Concrete overflow with steel plate flashboard. |
| Length | 35 feet (perpendicular to flow) |
| Crest elevation (flashboard) | 1402.0 |
| Upstream channel | Lake |
| Downstream channel | Concrete channel, plunge pool and then earth channel. |

SECTION 2
DESIGN DATA

## 2.1 Design

a. Data Available. The available data consist of files provided by the Commonwealth of Pennsylvania, Department of Environmental Resources (PennDER), which contain design drawings, correspondence and inspection reports.

(1) Hydrology and Hydraulics. Review of the information in the Commonwealth of Pennsylvania files showed that there are no original hydrology and hydraulic design data available for the dam. However, a state inspection report entitled "Report Upon the Application of Frank Turoski," dated August 26, 1957, contains the criteria used to size the spillway.

(2) Embankment. The available information consists of design drawings.

(3) Appurtenant Structures. The available information consists of design drawings.

b. Design Features

(1) Embankment. As designed, the dam is a homogeneous fill with an impervious core along the center line of the embankment, extending for the full length of the earth embankment. The core starts one foot below the crest of the dam and extends into the foundation through a seven-foot-deep cutoff trench. Plates 2 and 3 show the plan and typical cross section of the dam. The core is four feet wide on the top and ten feet wide at the original ground, below which a cutoff trench ten feet wide and seven feet deep was excavated. The specifications required that the core material consist of hardpan thoroughly mixed and compacted. Fill material was to be placed in horizontal layers eight inches in depth, each layer thoroughly incorporated with the material already in place. No internal drainage system was incorporated in the embankment design.

The embankment was designed to have a 2.5:1 (horizontal to vertical) slope on both upstream and downstream faces and a crest width of nine feet. The upstream face of the dam was to be covered with 12-inch hand-placed dry stone riprap not less than 12 inches deep.

(2) Appurtenant Structures. The appurtenant structures consist of a concrete open channel spillway located on the left abutment and the outlet works located near the center of the embankment. Details of the spillway are shown in Plates 2, 3 and 4. As designed, the spillway is a rectangular channel, 35 feet wide and five feet deep, at the control section. A concrete sill across the base of the channel constitutes the overflow section. The overflow section is equipped with a 12-inch-high steel plate flashboard.

The spillway discharge channel also is a rectangular concrete channel which terminates at a plunge pool 45 feet downstream from the overflow section. In the foundation of the spillway, a one-foot-thick, five-foot-deep cutoff wall extending to impervious material was provided to control seepage.

The outlet works consist of a 12-inch-diameter corrugated metal pipe encased in concrete. The upstream end of the pipe is attached to a concrete pier which supports a sluice gate. Details of the outlet works are shown on Plate 3.

c. Design Data

(1) Hydrology and Hydraulics. A Commonwealth of Pennsylvania report entitled "Report Upon the Application of Frank Turoski," dated August 26, 1957, indicates that the spillway was sized to pass a discharge of 1377 cfs with the water level two inches below the top of the dam and 1467 cfs with the water level at the top.

(2) Embankment. No engineering data are available on the design of the embankment.

(3) Appurtenant Structures. No engineering data are available on the appurtenant structures.

2.2 Construction. Available information indicated that construction of the dam was completed in 1957. To the extent that can be determined at this time, the dam appears to be higher than indicated in the design drawing. The design drawing shows the height of the dam to be 24 feet measured from the dam crest to the downstream invert of the outlet works. Field measurement indicates the height of the dam to be approximately 29 feet. Further, the slopes of the dam were designed to be 2.5H:1V, but field measurements indicate a downstream slope of 2H:1V.

2.3 Operation. There are no formal operating records maintained for the dam.

2.4 Other Investigations. The available information indicated no investigations other than the periodic inspections conducted by the state. The last state inspection was conducted in October 1964.

2.5 Evaluation

a. Availability. The available information was provided by the Commonwealth of Pennsylvania, Department of Environmental Resources.

b. Adequacy

(1) Hydrology and Hydraulics. The available information is limited. Only the watershed area reservoir volume and design discharge capacity of the spillway are reported.

(2) Embankment. Other than design drawings, no other data is available to assess the adequacy of the embankment design. No reference was found to indicate whether the design included slope stability and seepage analyses. However, the design does incorporate such basic components as an impervious cutoff trench and riprap protection of the upstream slope of the dam.

(3) Appurtenant Structures. Review of the design drawings indicate no significant deficiencies that would affect the structural performance of the appurtenant structure.

## SECTION 3
## VISUAL INSPECTION

### 3.1 Findings

a. General. The onsite inspection of Lake Sophia Dam consisted of:

1. Visual inspection of the embankment, abutments, and embankment toe.

2. Visual examination of the spillway and its components.

3. Evaluation of downstream area hazard potential.

The specific observations are illustrated in Plate 5.

b. Embankment. The general inspection of the embankment consisted of searching for indications of structural distress, such as cracks, subsidence, bulging, wet areas, seeps and boils, and observing general maintenance conditions, vegetative cover, erosion, and other surficial features.

In general, the condition of the embankment is considered to be fair. No major signs of distress such as slumps or cracks were found. However, extensive swampy areas were observed below the junction of the embankment with the abutments, which raised concern as to the effect of this apparent underseepage on the continued stability of the dam. A seepage in the amount of 10 to 20 gallons per minute was found to be associated with the swampy area on the right abutment. Precipitate was observed in the right abutment seepage. No measurable seepage was observed in the left abutment swampy area. Further, a portion of the toe of the dam was submerged by a pond formed by debris and a beaver dam blocking the outlet pipe discharge channel. This condition precluded inspection of the vicinity of the downstream end of the outlet pipe for possible seepage. Some shoreline erosion was observed along the upstream slope. Riprap on the upstream slope has partially dislocated and is not effective for controlling erosion, due to wave action.

The top of the dam was surveyed relative to the spillway crest elevation and the center of the dam was found to have apparently settled. While the design freeboard for the dam was 4 feet, the field survey indicated a freeboard of 2.8 feet between the low spot near the right embankment and the normal pool level.

c. Appurtenant Structures. The appurtenant structures were examined for deterioration or other signs of distress and obstructions that would limit flow. In general, the structures were found to be in fair condition. Steel I-beams were placed across the top of the spillway discharge channel, apparently to prevent tilting of the side walls of

the channel. Some structural cracks were observed in the side walls of the spillway discharge channel. Riprap in the spillway plunge pool was found to be in poor condition. It appears that the spillway discharge channel below the concrete section was not constructed in accordance with the design drawings which included a riprap channel extending to the original streambed. The operational condition of the outlet works could not be observed. The downstream end of the outlet pipe was submerged in ponded water and could not be inspected.

d. Reservoir Area. A map review indicates that the watershed is predominantly wood and pasturelands. A review of the regional geology is included in Appendix F.

e. Downstream Channel. The downstream channel flows approximately 1.4 miles to a highway bridge of Route 267 at the Village of Choconut. Further description of the downstream conditions is included in Section 1.2 d.

3.2 Evaluation. The condition of Lake Sophia Dam is considered to be fair. Although no major signs of distress were noted, in view of the seepage condition and apparent settlement of the embankment, further detailed evaluation of the condition of the dam by a professional engineer is recommended. Plans should be prepared to control the seepage conditions. In conjunction with this work, necessary work should be performed to restore the outlet facilities.

## SECTION 4
## OPERATIONAL FEATURES

4.1 Procedure. There are no formal operating procedures for the dam. The reservoir is normally maintained at the top of the spillway flashboards with excess inflow discharging over the uncontrolled spillway.

4.2 Maintenance of the Dam. The maintenance condition of the dam is considered to be good. It appears that grass on the crest and downstream face is periodically mowed.

4.3 Maintenance of Operating Facilities. The only operating facility for the dam is the outlet pipe valve. The pier supporting the controls was unaccessible. Operation of the gate was not observed.

4.4 Warning System. No formal warning system exists for the dam. Telephone communication facilities are available via residences at the dam site.

4.5 Evaluation. Although the maintenance condition of the embankment is considered to be good, the operating facilities are considered to be in poor condition. Evaluation of the operational condition of the outlet facilities are required.

## SECTION 5
## HYDRAULICS AND HYDROLOGY

### 5.1 Evaluation of Features

a. Design Data. Lake Sophia Dam has a watershed area of 1.47 square miles and impounds a reservoir with a surface area of 13.8 acres at normal pool level. Flow discharge facilities for the dam consist of a 35-foot-wide overflow spillway equipped with a 12-inch-high weir. Based on the available head relative to the low spot on the left embankment, the capacity of the spillway is estimated to be 540 cfs with no freeboard.

b. Experience Data. As previously stated, Lake Sophia Dam is classified as a small dam in the high hazard category. Under the recommended criteria for evaluating emergency spillway discharge capacity such impoundments are required to pass flows from one-half to full PMF. In view of the size and evaluation of the downstream damage potential, one-half PMF was selected as the spillway design flood.

The PMF inflow hydrograph for the reservoir was determined utilizing the Dam Safety Version of the HEC-1 computer program developed by the Hydrologic Engineering Center of the U.S. Army, Corps of Engineers. The data used for the computer analysis are presented in Appendix D. As determined by the computer program, the one-half and full PMF inflow hydrograph has a peak of 1956 cfs and 3911 cfs, respectively. Computer input and a summary of computer output are also included in Appendix D.

c. Visual Observations. On the dates of the inspections, no conditions were observed that would indicate that the spillway capacity would be significantly reduced in the event of a flood. It appears that the steel weir across the spillway might not fail under full spillway flow.

d. Overtopping Potential. Various percentages of the PMF inflow were routed through the reservoir and it was found that the dam can pass 15 percent of the PMF without overtopping the dam. For 50 percent of the PMF, it was found that the low area on the embankment would be overtopped for a duration of 5.25 hours with a maximum depth of 1.3 feet. It is estimated that overtopping of the dam by approximately 0.5 foot would initiate breaching of the dam. A further analysis indicates that if the steel weir is removed and the crest of the dam filled to design level, the dam would pass approximately 40 percent of the PMF.

e. Spillway Adequacy. Since the dam cannot pass the recommended design flood of one-half the PMF without overtopping the dam, the flood discharge capacity is classified to be inadequate. A breach analysis was conducted to analyze whether failure resulting from overtopping would significantly increase the potential for loss of life or damage over that which would exist just before overtopping failure. For breach analyses,

a trapezoidal breach was assumed with a 200-foot bottom width, 2H:1V side slopes, and a depth of 26 feet. The duration of failure was taken as 0.75 hour, and it was assumed that the breaching would initiate when the dam is overtopped by 0.5 foot. It was found that the dam would be overtopped by 0.5 foot during the passage of 25 percent of the PMF. The computer outputs for the breach analysis are included in Appendix D.

Review of the flood stages in the Village of Choconut resulting from failure of Lake Sophia Dam indicates that while the discharge from the dam before failure (920 cfs, 25 percent of the PMF) would be essentially within the banks of the stream, after failure the discharge from the dam would increase to about 5326 cfs, overtopping the stream banks by about 2.9 feet. This increase is considered to pose a significant increase in downstream damage potential. Therefore, the flood discharge capacity of Lake Sophia Dam is considered to be seriously inadequate.

## SECTION 6
## STRUCTURAL STABILITY

### 6.1 Evaluation of Structural Stability

a. Visual Observations

(1) Embankment. As discussed in Section 3, in view of the observed swampy and seepage conditions along the downstream toe of the dam and the fact that the embankment design does not include an internal drainage system for controlling the effects of seepage, a concern exists as to the effect of the observed conditions on the continued stability of the dam. Although at this time, no signs of major distress such as cracks, bulging and slumps were observed, detailed evaluation of the seepage conditions by a professional engineer is considered advisable. The dam appears to have settled. This condition should also be evaluated in conjunction with the above recommended work.

(2) Appurtenant Structures. Although some structural cracking was observed on the side walls of the spillway discharge channel, the overall structural condition is considered to be satisfactory. No portions of the outlet facilities were visible to assess their structural conditions.

b. Design and Construction Data

(1) Embankment. The available design and construction information does not provide any quantitative data to aid in the assessment of stability. However, as previously noted, concerns exist as to the continued stability of the dam in view of the observed seepage and swampy conditions. Further detailed investigation of the stability of the dam is considered to be required.

(2) Appurtenant Structures. Other than design drawings, no design and construction data exists for the appurtenant structures. Review of these drawings indicated no apparent structural deficiencies that would significantly affect the performance of the appurtenant structures.

c. Operating Records. None available.

d. Postconstruction Changes. It appears that the spillway flashboards were installed after the completion of the dam.

e. Seismic Stability. The dam is located in Seismic Zone 1; and based on visual observations, the static stability of the dam is considered to be questionable. Therefore, seismic stability of the dam should also be evaluated in conjunction with further investigation of the dam.

## SECTION 7
## ASSESSMENT AND RECOMMENDATIONS/PROPOSED REMEDIAL MEASURES

### 7.1 Dam Assessment

a. Assessment. In view of the seriously inadequate spillway capacity, the condition of Lake Sophia Dam is classified to be unsafe/nonemergency. The condition of the embankment is considered to be fair. Seepage and swampy conditions were observed below the toe of the dam, raising concern relative to the continued stability of the dam. Further detailed investigation of the dam by a professional engineer is recommended.

The spillway was evaluated according to the recommended procedure and was found to pass 15 percent of the PMF without overtopping the dam. This capacity is less than the spillway design flood of one-half PMF. Results of the breach analysis indicate that downstream damage would be significantly increased due to a dam failure and, as a result, the spillway is classified as seriously inadequate.

b. Adequacy of Information. The available information, in conjunction with visual observations, is considered to be sufficient to make a Phase I evaluation.

c. Urgency. The following recommendations should be implemented as soon as possible or on a continuing basis.

d. Necessity for Additional Investigations. In view of the seriously inadequate spillway capacity, the owner should retain a professional engineer to determine the nature and extent of improvements required to provide an adequate spillway and to prepare and execute plans for controlling the seepage conditions and evaluating the stability of the dam.

### 7.2 Recommendations/Remedial Measures.

It is recommended that:

1. The owner should immediately retain a professional engineer to conduct additional studies to more accurately ascertain the spillway capacity and the nature and extent of improvements required to provide adequate spillway capacity. In the interim, the spillway weir should be immediately removed and the crest of the dam should be filled to the design level.

2. In conjunction with the above work, investigations should be undertaken to prepare and execute plans for controlling seepage along the downstream toe and for evaluating the structural integrity of the embankment in view of observed conditions.

3. The owner should confirm the operational condition of the outlet works and perform necessary maintenance, if found inoperative.

4. Around-the-clock surveillance should be provided during unusually heavy runoff and a formal warning system should be developed to alert the downstream residents in the event of an emergency.

5. The owner should develop a formal operating and maintenance plan for the dam, inspect the dam regularly and perform necessary maintenance.

# APPENDIX A

## CHECKLIST
## VISUAL INSPECTION
## PHASE I

APPENDIX A

CHECKLIST
VISUAL INSPECTION
PHASE I

NAME OF DAM Lake Sophia COUNTY Susquehanna STATE Pennsylvania ID# NDI: PA-0078 DER: 058-126

TYPE OF DAM Earth HAZARD CATEGORY High

DATE(S) INSPECTION March 23, 1981 WEATHER Cloudy TEMPERATURE 40

POOL ELEVATION AT TIME OF INSPECTION 1402 M.S.L. (Top of Flashboard) TAILWATER AT TIME OF INSPECTION 1376± M.S.L.

| INSPECTION PERSONNEL: | REVIEW INSPECTION PERSONNEL: (April 30, 1981) |
|---|---|
| Arthur Smith | Lawrence D. Andersen |
| Wah-Tak Chan | James H. Poellot |
| Bilgin Erel | Bilgin Erel |

Owner's Representative: None

Bilgin Erel RECORDER

VISUAL INSPECTION
PHASE I
EMBANKMENT

| VISUAL EXAMINATION OF | OBSERVATIONS | REMARKS OR RECOMMENDATIONS |
|---|---|---|
| SURFACE CRACKS | None observed. | |
| UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE | None observed. | |
| SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES | None observed. | |
| VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST | See Plate 6 for dam crest profile. No significant horizontal misalignment observed. | |
| RIPRAP FAILURES | Existing riprap is not effective against wave action. | Adequate shoreline erosion protection (e.g., riprap) should be provided along the upstream slope of the dam. |

VISUAL INSPECTION
PHASE I
EMBANKMENT

| VISUAL EXAMINATION OF | OBSERVATIONS | REMARKS OR RECOMMENDATIONS |
|---|---|---|
| JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM | No problem observed. | |
| ANY NOTICEABLE SEEPAGE | Swampy areas below the toe of the dam along both abutments. See Plate 5 for location. | Further investigation of this condition is recommended. |
| STAFF GAGE AND RECORDER | None | |
| DRAINS | None observed. | |
| | | |

VISUAL INSPECTION
PHASE I
EMBANKMENT

| VISUAL EXAMINATION OF | OBSERVATIONS | REMARKS OR RECOMMENDATIONS |
|---|---|---|
| JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM | No problem observed. | |
| ANY NOTICEABLE SEEPAGE | Swampy areas below the toe of the dam along both abutments. See Plate 5 for location. | Further investigation of this condition is recommended. |
| STAFF GAGE AND RECORDER | None | |
| DRAINS | None observed. | |
| | | |

VISUAL INSPECTION
PHASE I
OUTLET WORKS

| VISUAL EXAMINATION OF | OBSERVATIONS | REMARKS OR RECOMMENDATIONS |
|---|---|---|
| CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT | Downstream end of the outlet pipe is submerged. Not visible. | |
| INTAKE STRUCTURE | Submerged. Not visible. | |
| OUTLET STRUCTURE | None | |
| OUTLET CHANNEL | Earth channel. Channel is blocked by debris and a beaver dam, ponding water in the channel. | The pond in the outlet channel should be drained. |
| EMERGENCY GATE | Upstream end sluice gate. Operating equipment accessible by boat only. Operation of the gate not observed. | Operational condition of the outlet pipe gate should be confirmed by the owner. |

VISUAL INSPECTION
PHASE I
UNGATED SPILLWAY

| VISUAL EXAMINATION OF | OBSERVATIONS | REMARKS OR RECOMMENDATIONS |
|---|---|---|
| CONCRETE WEIR | Concrete overflow section equipped with a 12-inch steel plate flashboard. | The flashboard should be removed. |
| APPROACH CHANNEL | Lake. No problems observed. | |
| DISCHARGE CHANNEL | Rectangular concrete channel in fair condition. | |
| BRIDGE AND PIERS | None | |
| | | |

VISUAL INSPECTION
PHASE I
GATED SPILLWAY

| VISUAL EXAMINATION OF | OBSERVATIONS | REMARKS OR RECOMMENDATIONS |
|---|---|---|
| CONCRETE SILL | The dam has no gated spillway. | |
| APPROACH CHANNEL | None | |
| DISCHARGE CHANNEL | None | |
| BRIDGE PIERS | None | |
| GATES AND OPERATION EQUIPMENT | None | |

VISUAL INSPECTION
PHASE I
INSTRUMENTATION

| VISUAL EXAMINATION OF | OBSERVATIONS | REMARKS OR RECOMMENDATIONS |
|---|---|---|
| MONUMENTATION/SURVEYS | None | |
| OBSERVATION WELLS | None | |
| WEIRS | None | |
| PIEZOMETERS | None | |
| OTHER | None | |

VISUAL INSPECTION
PHASE I
RESERVOIR

| VISUAL EXAMINATION OF | OBSERVATIONS | REMARKS OR RECOMMENDATIONS |
|---|---|---|
| SLOPES | No problems observed. | |
| SEDIMENTATION | Unknown | |
| UPSTREAM RESERVOIRS | None | |
| | | |
| | | |

VISUAL INSPECTION
PHASE I
DOWNSTREAM CHANNEL

| VISUAL EXAMINATION OF | OBSERVATIONS | REMARKS OR RECOMMENDATIONS |
|---|---|---|
| CONDITION (OBSTRUCTIONS, DEBRIS, ETC.) | No problems observed. | |
| SLOPES | No problems observed. | |
| APPROXIMATE NUMBER OF HOMES AND POPULATION | Village of Choconut is about 1.4 miles downstream from the dam. Population: 10 to 20. | |
| | | |
| | | |

# APPENDIX B

## CHECKLIST
## ENGINEERING DATA
## DESIGN, CONSTRUCTION, OPERATION
## AND HYDROLOGIC AND HYDRAULIC
## PHASE I

APPENDIX B

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM Lake Sophia

ID# NDI: PA-0078
DER: 058-126

| ITEM | REMARKS |
|---|---|
| AS-BUILT DRAWINGS | Three design drawings are available in state files. |
| REGIONAL VICINITY MAP | See Plate 1. |
| CONSTRUCTION HISTORY | Construction was completed in November 1957. The dam was designed by V. S. Scandale and N. C. Scandale, professional engineers. |
| TYPICAL SECTIONS OF DAM | See Plate 3. |
| OUTLETS - PLAN<br>- DETAILS<br>- CONSTRAINTS<br>- DISCHARGE RATINGS | See Plates 2, 3 and 4. |

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

| ITEM | REMARKS |
|---|---|
| RAINFALL/RESERVOIR RECORDS | None |
| DESIGN REPORTS | None |
| GEOLOGY REPORTS | None |
| DESIGN COMPUTATIONS<br>HYDROLOGY & HYDRAULICS<br>DAM STABILITY<br>SEEPAGE STUDIES | Limited hydrology and hydraulics calculations are available in state files. |
| MATERIALS INVESTIGATIONS<br>BORING RECORDS<br>LABORATORY<br>FIELD | None reported |

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

| ITEM | REMARKS |
|---|---|
| POST CONSTRUCTION SURVEYS OF DAM | None |
| BORROW SOURCES | Unknown |
| MONITORING SYSTEMS | None |
| MODIFICATIONS | None |
| HIGH POOL RECORDS | Unknown |

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

| ITEM | REMARKS |
|---|---|
| POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS | None reported. |
| PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS | None reported. |
| MAINTENANCE OPERATION RECORDS | No maintenance records kept for the dam. |
| SPILLWAY PLAN<br><br>SECTIONS<br><br>DETAILS | See Plate 4. |
| OPERATING EQUIPMENT PLANS AND DETAILS | See Plates 3 and 4. |

CHECKLIST
ENGINEERING DATA
HYDROLOGIC AND HYDRAULIC

DRAINAGE AREA CHARACTERISTICS: Partly wooded and pastureland

ELEVATION, TOP OF NORMAL POOL AND STORAGE CAPACITY: 1402 (120 acre-feet)

ELEVATION, TOP OF FLOOD CONTROL POOL AND STORAGE CAPACITY: 1404.8 (164 acre-feet)

ELEVATION, MAXIMUM DESIGN POOL: 1406 (design top of dam)

ELEVATION, TOP OF DAM: 1404.8 (low spot)

SPILLWAY:

a. Elevation 1401, top of flashboard 1402

b. Type Sharp crested overflow section

c. Width 35 feet (perpendicular to flow direction)

d. Length 45 feet

e. Location Spillover Near left abutment

f. Number and Type of Gates None

OUTLET WORKS:

a. Type 12-inch corrugated metal pipe

b. Location Near center of dam, along original streambed

c. Entrance Inverts Unknown

d. Exit Inverts Unknown

e. Emergency Drawdown Facilities 12-inch-diameter corrugated metal pipe

HYDROMETEOROLOGICAL GAGES:

a. Type None

b. Location None

c. Records None

MAXIMUM NONDAMAGING DISCHARGE: 540 cfs existing spillway capacity

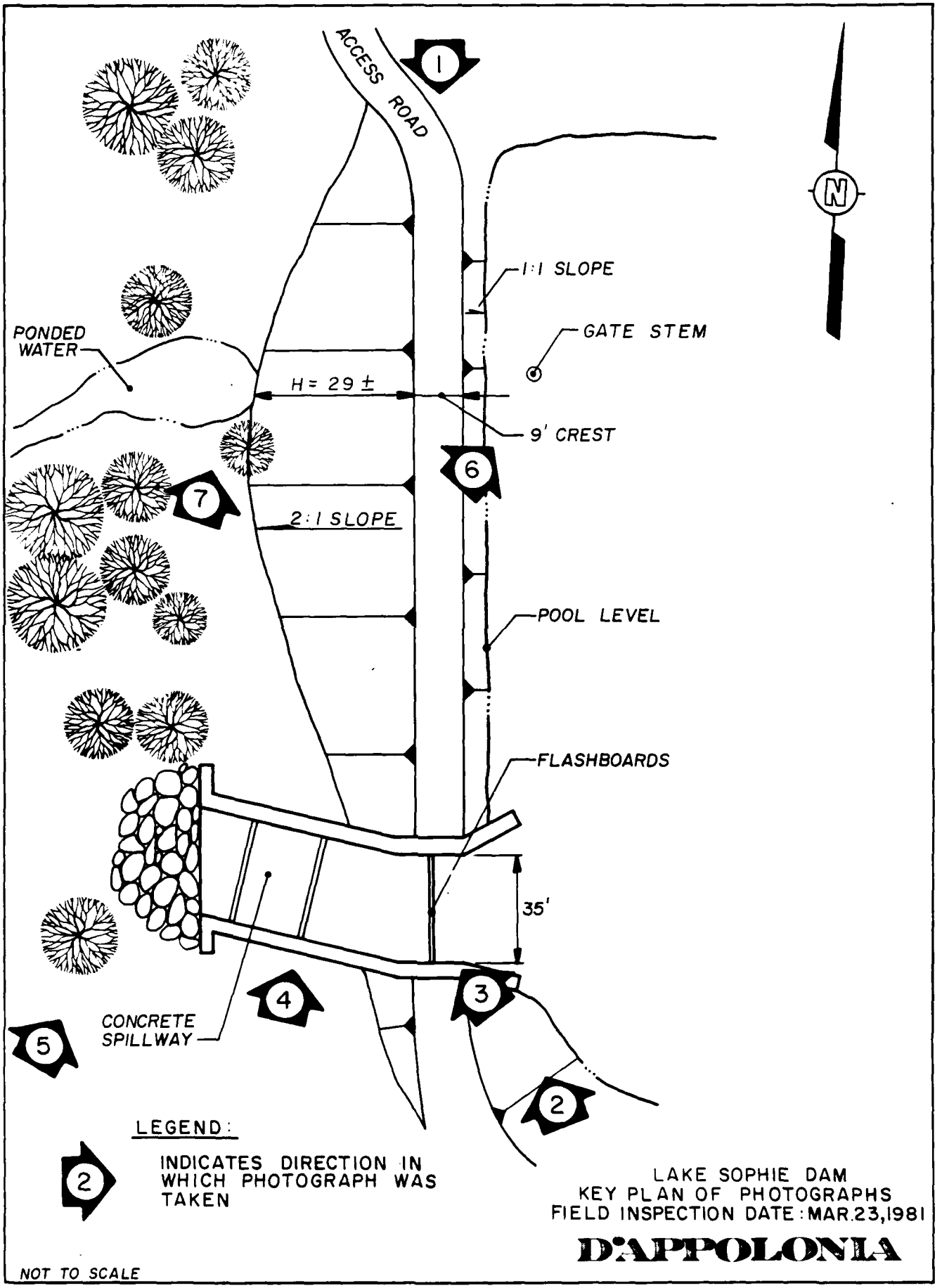
# APPENDIX C

# PHOTOGRAPHS

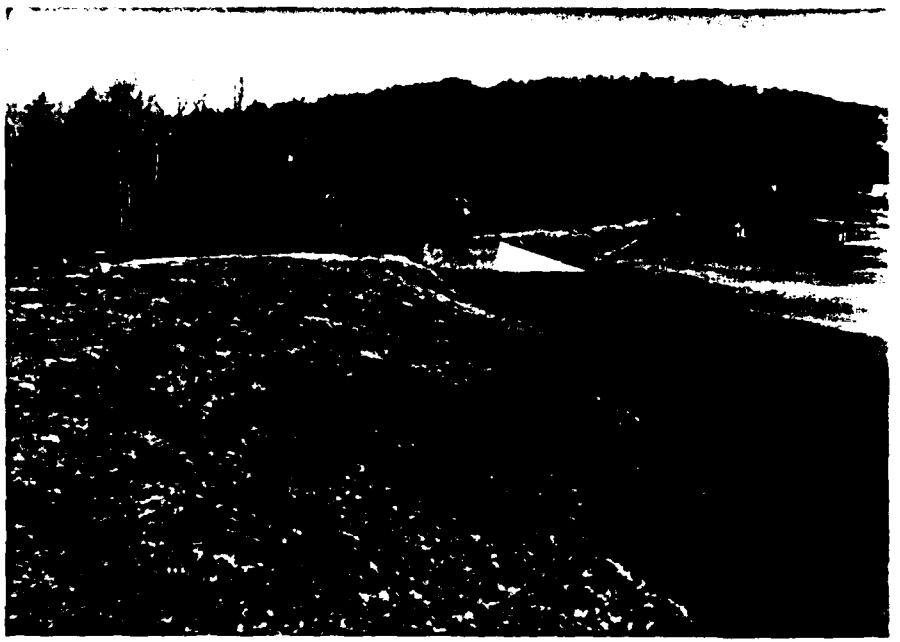
LIST OF PHOTOGRAPHS
LAKE SOPHIA DAM
NDI I.D. NO. PA-0078
MARCH 23, 1981

| PHOTOGRAPH NO. | DESCRIPTION |
|---|---|
| 1 | Dam crest (looking south). |
| 2 | Dam crest (looking north). |
| 3 | Spillway overflow section, note steel plate flashboards. |
| 4 | Spillway wall. |
| 5 | Downstream slope of dam and spillway. |
| 6 | Gate stem. |
| 7 | Ponded water at toe of dam. |
| 8 | Houses approximately 1.4 miles downstream from dam. |

8' 556

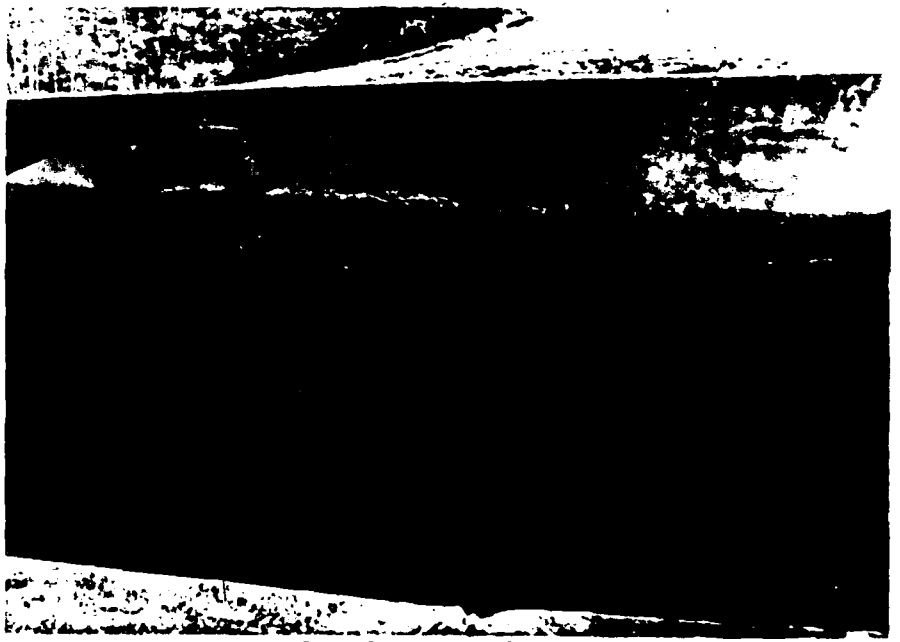


PHOTOGRAPH NO. 1



PHOTOGRAPH NO. 2

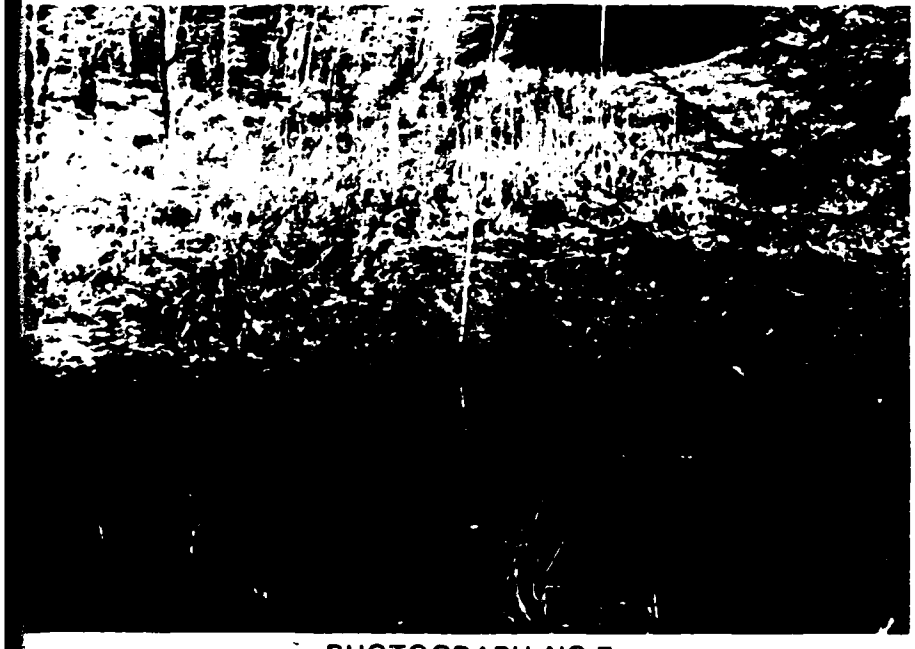
PHOTOGRAPH NO. 3



PHOTOGRAPH NO. 4

PHOTOGRAPH NO. 5

PHOTOGRAPH NO. 6



PHOTOGRAPH NO.7

PHOTOGRAPH NO. 8

# APPENDIX D

# HYDROLOGY AND HYDRAULICS ANALYSES

HYDROLOGY AND HYDRAULIC ANALYSIS
DATA BASE

NAME OF DAM: Lake Sophia Dam

PROBABLE MAXIMUM PRECIPITATION (PMP) = 22.2 INCHES/24 HOURS

| STATION | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Station Description | Lake Sophia | Lake Sophia Dam | | | |
| Drainage Area (square miles) | 1.47 | - | | | |
| Cumulative Drainage Area (square miles) | 1.47 | 1.47 | | | |
| Adjustment of PMF for Drainage Area (%)(1) | 94% | | | | |
| 6 Hours | 117 | - | | | |
| 12 Hours | 127 | - | | | |
| 24 Hours | 136 | - | | | |
| 48 Hours | 142 | - | | | |
| 72 Hours | 145 | - | | | |
| Snyder Hydrograph Parameters | | | | | |
| Zone(2) | 11A | - | | | |
| $C_p/C_t$(3) | 0.62/1.50 | - | | | |
| L (miles)(4) | 1.65 | - | | | |
| $L_{ca}$ (miles)(4) | 0.51 | - | | | |
| $t_p = C_t(L \cdot L_{ca})^{0.3}$ (hours) | 1.42 | - | | | |
| Spillway Data | | | | | |
| Crest Length (ft) | - | 35.0 | | | |
| Freeboard (ft) | - | 2.8 | | | |
| Discharge Coefficient | - | 3.3 | | | |
| Exponent | - | 1.5 | | | |

(1) Hydrometeorological Report 40, U.S. Weather Bureau, 1965.
(2) Hydrological zone defined by Corps of Engineers, Baltimore District, for determining Snyder's Coefficients ($C_p$ and $C_t$).
(3) Snyder's Coefficients.
(4) L = Length of longest water course from outlet to basin divide.
$L_{ca}$ = Length of water course from outlet to point opposite the centroid of drainage area.

STORAGE VS. ELEVATION

| ELEVATION | ΔH, FEET | AREA (acres)(1) | ΔVOLUME (acre-feet)(2) | STORAGE (acre-feet) |
|---|---|---|---|---|
| 1420.0 | | 47.8 | | 643.6 |
| | 18.0 | | 524.0 | |
| 1402.0 | | 13.8 | | 119.6 |
| | 26.0 | | 119.6 | |
| 1376.0 | | 0 | | 0 |
| | | | | |

(1) Planimetered from USGS maps.
(2) $\Delta Volume = \Delta H/3 \ (A_1 + A_2 + \sqrt{A_1 A_2})$.

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  01 APR 80
**********
    1                A1       SNYDER UNIT HYDROGRAPH, SPILLWAY, OVERTOPPING AND DAM BREACH ANALYSES
    2                A2       LAKE SOPHIA DAM,(DER 58-126),SUSQUEHENNA COUNTY,PA. PROJECT NO.80-556-19
    3                A3       FOR 15%,25%,50%,60%,80%,AND 100% PROBABLE MAXIMUM FLOOD(PMF)
    4                B     00       0      15       0       0       0       0       0      -4       0
    5                B1     5
    6                J      2       6       1
    7                J1  0.15    0.25    0.50    0.60    0.80    1.00
    8                K      0       1                                       1
    9                K1       CALCULATION OF SNYDER INFLOW HYDROGRAPH TO LAKE SOPHIA DAM,(DER 58-126)
   10                M      1       1    1.47            1.47                                       1
   11                P            20.9     117     127     136     142     145
   12                T                                                    1.0     0.5           0.0146
   13                W   1.42    0.62
   14                X   -1.5   -0.05     2.0
   15                K      1       2                                       1
   16                K1       ROUTING FLOW THROUGH LAKE SOPHIA DAM,(DER 58-126)
   17                Y                                       1       1
   18                Y1     1                                           -1402.0
   19                SA   0.0    13.8    47.8
   20                SE1376.0  1402.0  1420.0
   21                SS1402.0    35.0     3.3     1.5
   22                SD1404.8     2.65     1.5   450.0
   23                SL  50.0   100.0   150.0   200.0   300.0   325.0   350.0   375.0   425.0   450.0
   24                SV1404.8  1404.9  1405.3  1405.4  1405.5  1405.8  1406.0  1406.4  1406.5  1406.6
   25                SB 200.0     2.0  1380.0    0.75  1402.0  1420.0
   26                SB 200.0     2.0  1380.0    0.75  1402.0  1405.3
   27                K      1       3                                       1
   28                K1       CHANNEL ROUTING USING MODIFIED PULS: REACH 1 (STATION 0+00 TO 34+00)
   29                Y                                       1       1
   30                Y1     1
   31                Y6 0.045   0.045   0.045  1260.0  1269.5  3400.0  0.0390
   32                Y7   0.0  1300.0    80.0  1290.0   100.0  1290.0   200.0  1280.0   300.0  1260.0
   33                Y7 310.0  1260.0   390.0  1280.0   450.0  1300.0
   34                K      1       4                                       1
   35                K1       CHANNEL ROUTING USING MODIFIED PULS: REACH 2 (STATION 34+00 TO 74+65)
   36                Y                                       1       1
   37                Y1     1
   38                Y6 0.045   0.040   0.035  1090.0  1099.5  4065.0  0.0390
   39                Y7   0.0  1120.0    50.0  1100.0    90.0  1095.0    91.0  1090.0    99.0  1090.0
   40                Y7 100.0  1095.0   250.0  1100.0  1050.0  1120.0
   41                K     99
```

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

| OPERATION | STATION | AREA | PLAN | RATIOS APPLIED TO FLOWS<br>RATIO 1<br>.15 | RATIO 2<br>.25 | RATIO 3<br>.50 | RATIO 4<br>.60 | RATIO 5<br>.80 | RATIO 6<br>1.00 |
|---|---|---|---|---|---|---|---|---|---|
| HYDROGRAPH AT | 1 | 1.47 | 1 | 587. | 978. | 1956. | 2347. | 3129. | 3911. |
| | ( | 3.81) | ( | 16.61)( | 27.69)( | 55.38)( | 66.45)( | 88.60)( | 110.75)( |
| | | | 2 | 587. | 978. | 1956. | 2347. | 3129. | 3911. |
| | | | ( | 16.61)( | 27.69)( | 55.38)( | 66.45)( | 88.60)( | 110.75)( |
| ROUTED TO | 2 | 1.47 | 1 | 501. | 923. | 1932. | 2319. | 3092. | 3867. |
| | ( | 3.81) | ( | 14.18)( | 26.13)( | 54.70)( | 65.67)( | 87.55)( | 109.50)( |
| | | | 2 | 501. | 5108. | 6102. | 5708. | 5677. | 5950. |
| | | | ( | 14.18)( | 144.64)( | 172.80)( | 161.64)( | 160.75)( | 168.49)( |
| ROUTED TO | 3 | 1.47 | 1 | 501. | 927. | 1935. | 2325. | 3103. | 3879. |
| | ( | 3.81) | ( | 14.17)( | 26.26)( | 54.80)( | 65.84)( | 87.86)( | 109.84)( |
| | | | 2 | 501. | 5662. | 6541. | 6166. | 6168. | 6416. |
| | | | ( | 14.17)( | 160.32)( | 185.22)( | 174.59)( | 174.65)( | 181.67)( |
| ROUTED TO | 4 | 1.47 | 1 | 499. | 922. | 1928. | 2318. | 3102. | 3881. |
| | ( | 3.81) | ( | 14.12)( | 26.10)( | 54.60)( | 65.63)( | 87.84)( | 109.91)( |
| | | | 2 | 499. | 5326. | 6081. | 5715. | 5768. | 6025. |
| | | | ( | 14.12)( | 150.81)( | 172.19)( | 161.76)( | 163.33)( | 170.62)( |

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

| | INITIAL VALUE | SPILLWAY CREST | TOP OF DAM |
|---|---|---|---|
| ELEVATION | 1402.00 | 1402.00 | 1404.80 |
| STORAGE | 120. | 120. | 164. |
| OUTFLOW | 0. | 0. | 541. |

| RATIO OF PMF | MAXIMUM RESERVOIR W.S.ELEV | MAXIMUM DEPTH OVER DAM | MAXIMUM STORAGE AC-FT | MAXIMUM OUTFLOW CFS | DURATION OVER TOP HOURS | TIME OF MAX OUTFLOW HOURS | TIME OF FAILURE HOURS |
|---|---|---|---|---|---|---|---|
| .15 | 1404.66 | 0.00 | 161. | 501. | 0.00 | 41.75 | 0.00 |
| .25 | 1405.44 | .64 | 175. | 923. | 3.00 | 41.25 | 0.00 |
| .50 | 1406.14 | 1.34 | 189. | 1932. | 5.25 | 41.25 | 0.00 |
| .60 | 1406.34 | 1.54 | 193. | 2319. | 5.75 | 41.25 | 0.00 |
| .80 | 1406.68 | 1.88 | 200. | 3092. | 6.75 | 41.25 | 0.00 |
| 1.00 | 1406.97 | 2.17 | 206. | 3867. | 7.25 | 41.00 | 0.00 |

PLAN 2 .....

| | INITIAL VALUE | SPILLWAY CREST | TOP OF DAM |
|---|---|---|---|
| ELEVATION | 1402.00 | 1402.00 | 1404.80 |
| STORAGE | 120. | 120. | 164. |
| OUTFLOW | 0. | 0. | 541. |

| RATIO OF PMF | MAXIMUM RESERVOIR W.S.ELEV | MAXIMUM DEPTH OVER DAM | MAXIMUM STORAGE AC-FT | MAXIMUM OUTFLOW CFS | DURATION OVER TOP HOURS | TIME OF MAX OUTFLOW HOURS | TIME OF FAILURE HOURS |
|---|---|---|---|---|---|---|---|
| .15 | 1404.66 | 0.00 | 161. | 501. | 0.00 | 41.75 | 0.00 |
| .25 | 1405.37 | .57 | 174. | 6970. | .93 | 41.38 | 41.00 |
| .50 | 1405.52 | .72 | 177. | 7686. | 1.19 | 40.38 | 40.00 |
| .60 | 1405.39 | .59 | 174. | 7311. | .93 | 39.88 | 39.50 |
| .80 | 1405.48 | .68 | 176. | 7389. | .94 | 39.38 | 39.00 |
| 1.00 | 1405.59 | .79 | 178. | 7646. | .96 | 39.13 | 38.75 |

OVERTOPPING AND DAM BREACH RESULTS
LAKE SOPHIA DAM
PLAN 1: OVERTOPPING ANALYSIS
PLAN 2: DAM BREACH ANALYSIS

PLAN 1 STATION 3

| RATIO | MAXIMUM FLOW,CFS | MAXIMUM STAGE,FT | TIME HOURS |
|---|---|---|---|
| .15 | 501. | 1262.5 | 41.75 |
| .25 | 927. | 1263.4 | 41.50 |
| .50 | 1935. | 1264.7 | 41.25 |
| .60 | 2325. | 1265.1 | 41.25 |
| .80 | 3103. | 1265.8 | 41.25 |
| 1.00 | 3879. | 1266.4 | 41.25 |

PLAN 2 STATION 3

| RATIO | MAXIMUM FLOW,CFS | MAXIMUM STAGE,FT | TIME HOURS |
|---|---|---|---|
| .15 | 501. | 1262.5 | 41.75 |
| .25 | 5662. | 1267.6 | 41.50 |
| .50 | 6541. | 1268.0 | 40.50 |
| .60 | 6166. | 1267.8 | 40.00 |
| .80 | 6168. | 1267.8 | 39.50 |
| 1.00 | 6416. | 1268.0 | 39.25 |

PLAN 1 STATION 4

| RATIO | MAXIMUM FLOW,CFS | MAXIMUM STAGE,FT | TIME HOURS |
|---|---|---|---|
| .15 | 499. | 1094.4 | 41.75 |
| .25 | 922. | 1096.0 | 41.50 |
| .50 | 1928. | 1097.2 | 41.25 |
| .60 | 2318. | 1097.5 | 41.25 |
| .80 | 3102. | 1097.9 | 41.25 |
| 1.00 | 3881. | 1098.3 | 41.25 |

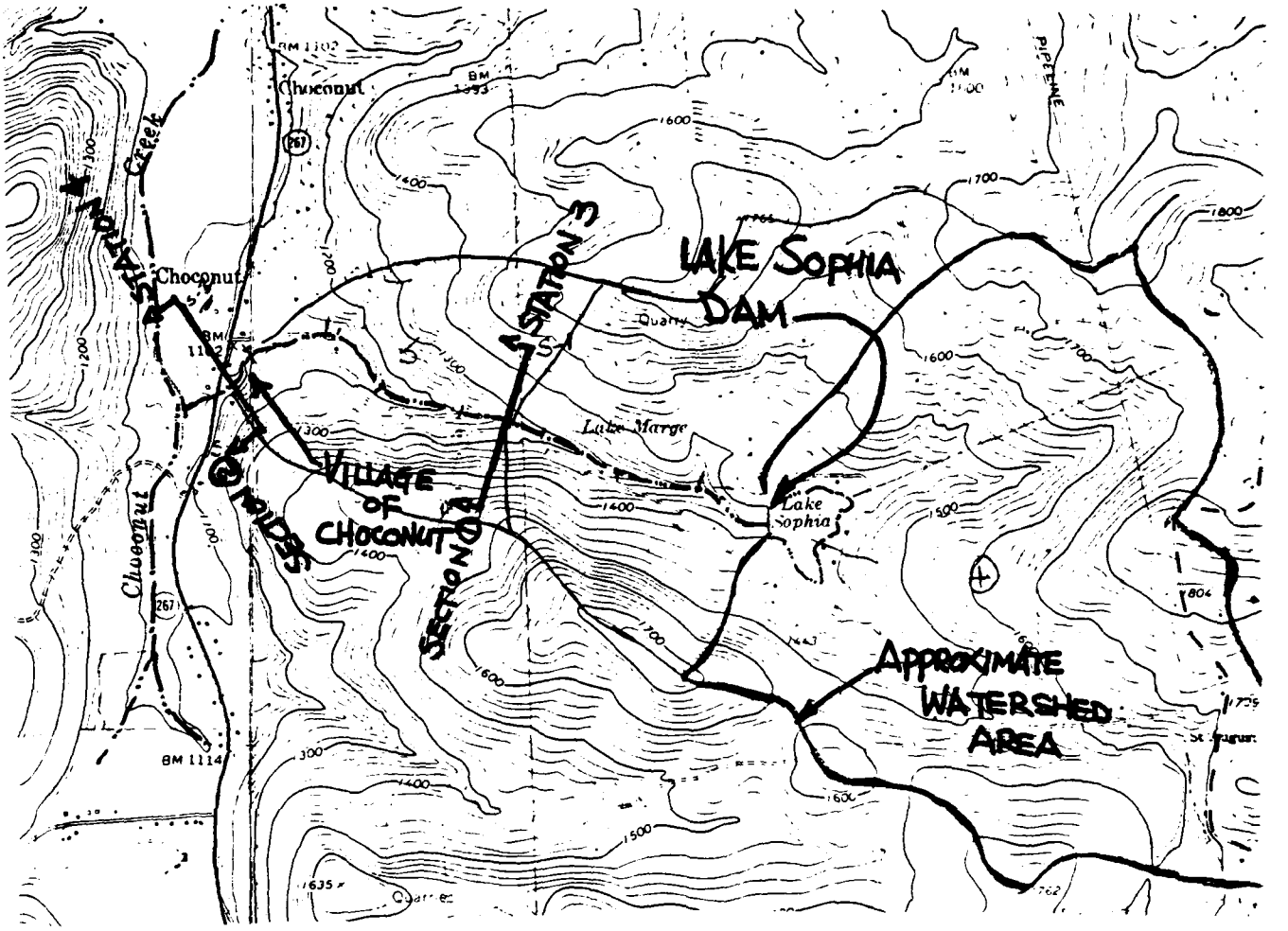
PLAN 2 STATION 4

| RATIO | MAXIMUM FLOW,CFS | MAXIMUM STAGE,FT | TIME HOURS |
|---|---|---|---|
| .15 | 499. | 1094.4 | 41.75 |
| .25 | 5326. | 1098.9 | 41.50 |
| .50 | 6081. | 1099.1 | 40.50 |
| .60 | 5713. | 1099.0 | 40.00 |
| .80 | 5768. | 1099.0 | 39.50 |
| 1.00 | 6025. | 1099.1 | 39.25 |

DOWNSTREAM CHANNEL ROUTING RESULTS
PLAN 1: DUE TO OVERTOPPING ONLY
PLAN 2: DUE TO DAM BREACH

D'APPOLONIA
CONSULTING ENGINEERS, INC.

By MB Date 4/25/21 Subject LAKE SOPHIA Sheet No. 1 of 4
Chkd. By WJC Date 4/25/21 DOWNSTREAM ROUTING Proj. No. 80-556-19



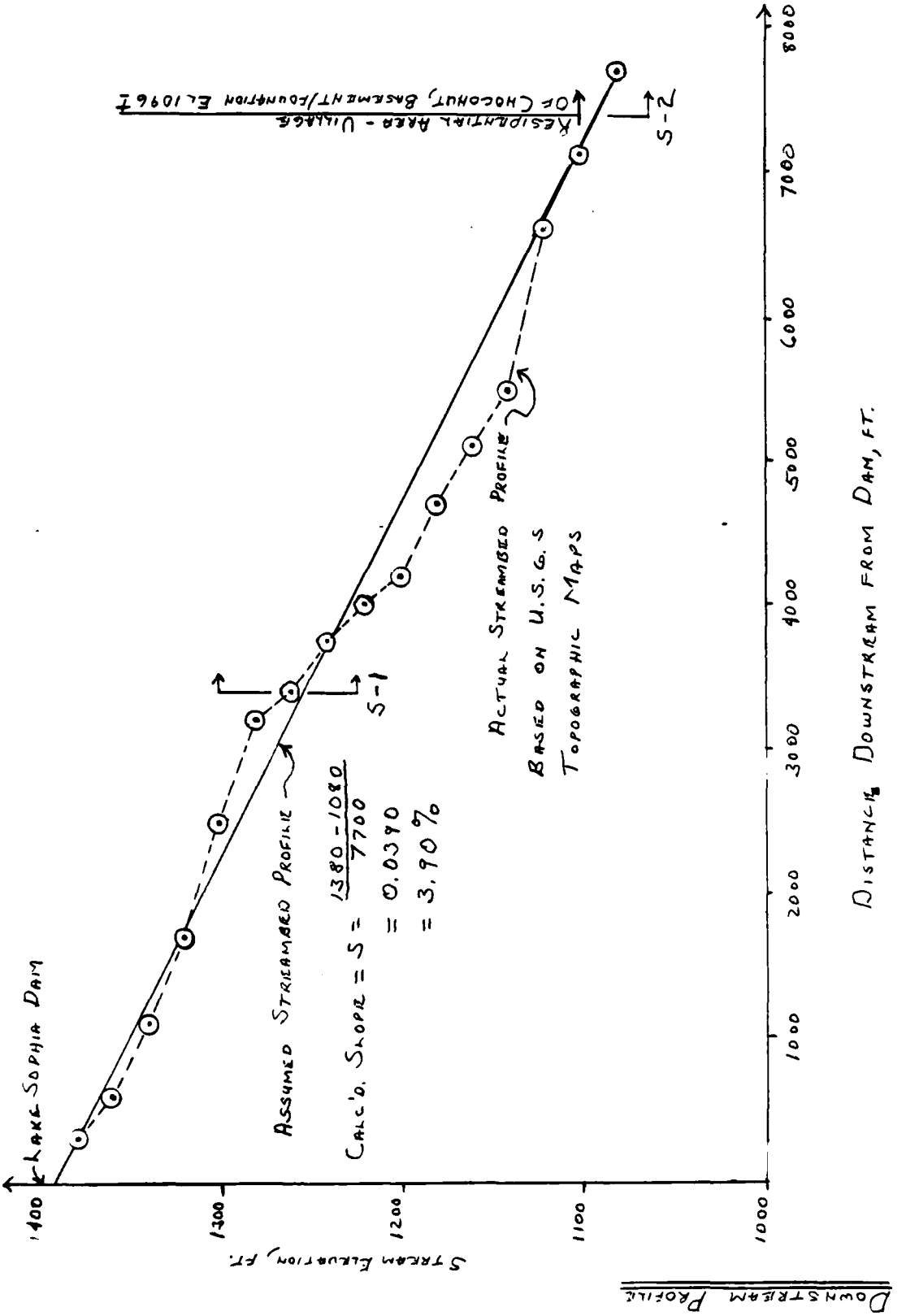

PLAN

SCALE 1" = 2000'

1000 0 1000 2000 3000 4000 FEET

D'APPOLONIA
CONSULTING ENGINEERS, INC.

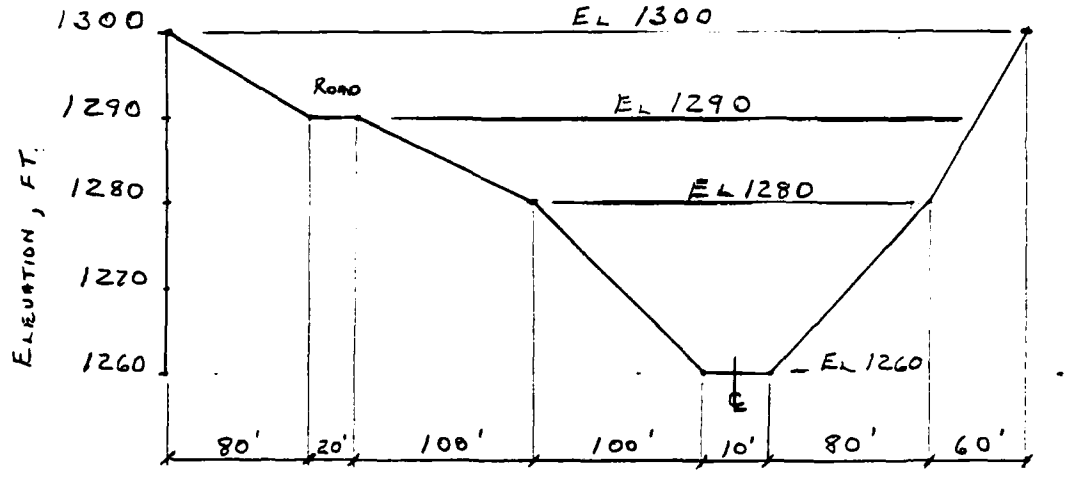
By MB Date 9/25/81 Subject LAKE SOPHIA Sheet No. 2 of 4
Chkd. By WTC Date 9/25/81 DOWNSTREAM ROUTING Proj. No. 80-556-19



D'APPOLONIA
CONSULTING ENGINEERS, INC.

By MB Date 4/25/81 Subject LAKE SOPHIA Sheet No. 3 of 4
Chkd. By WTC Date 4/25/81 DOWNSTREAM ROUTING Proj. No. 80-556-19

SECTION 1 (1) LOOKING DOWNSTREAM
REACH 1 : FROM STATION 0+00 TO STATION 34+00




| DISTANCE | ELEVATION |
|---|---|
| 0.0 | 1300.0 |
| 80.0 | 1290.0 |
| 100.0 | 1290.0 |
| 200.0 | 1280.0 |
| 300.0 | 1260.0 |
| 310.0 | 1260.0 |
| 390.0 | 1280.0 |
| 450.0 | 1300.0 |

L = 3900.0'
S = 0.0390

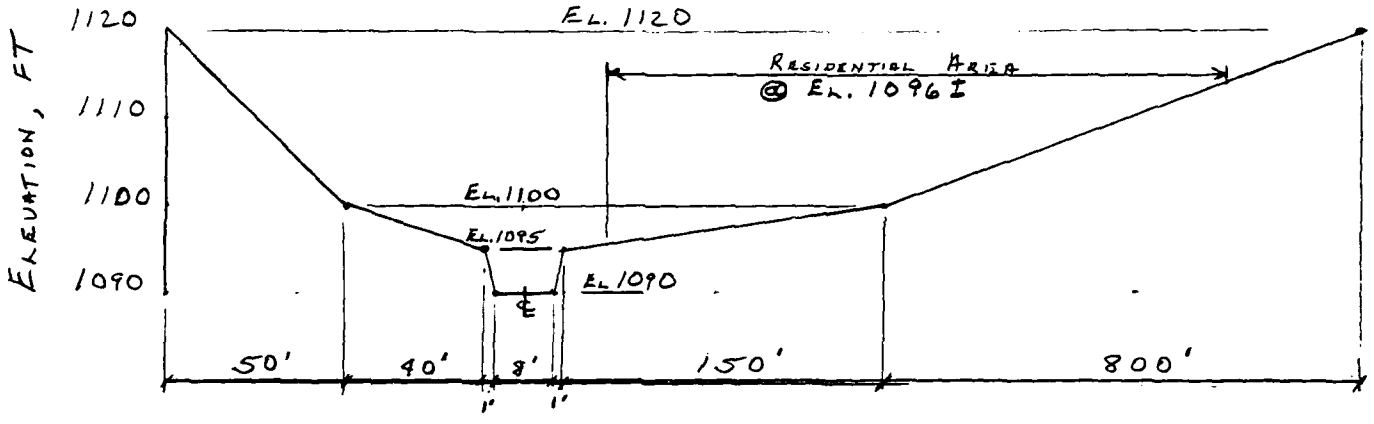
ESTIMATED 10 FT. STREAM WIDTH

(1) REFERENCE: USGS MAP, 7.5 MINUTE SERIES, SCALE: 1" = 2000 FT
(1) FRIENDSVILLE QUADRANGLE, PA.-N.Y., PHOTOREVISED 1978
(2) LAUREL LAKE QUADRANGLE, PA.-N.Y., PHOTOREVISED 1978

D'APPOLONIA
CONSULTING ENGINEERS, INC.

By MB Date 4/25/81 Subject LAKE SOPHIA Sheet No. 4 of 4
Chkd. By WTC Date 4/25/81 DOWNSTREAM ROUTING Proj. No. 80-556-19

SECTION 2 LOOKING DOWNSTREAM
REACH 2 : FROM STATION 34+00 TO STATION 74+65




| DISTANCE | ELEVATION |
|---|---|
| 0.0 | 1120.0 |
| 50.0 | 1100.0 |
| 90.0 | 1095.0 |
| 91.0 | 1090.0 |
| 99.0 | 1090.0 |
| 100.0 | 1095.0 |
| 250.0 | 1100.0 |
| 1050.0 | 1120.0 |

L = 4065.0'

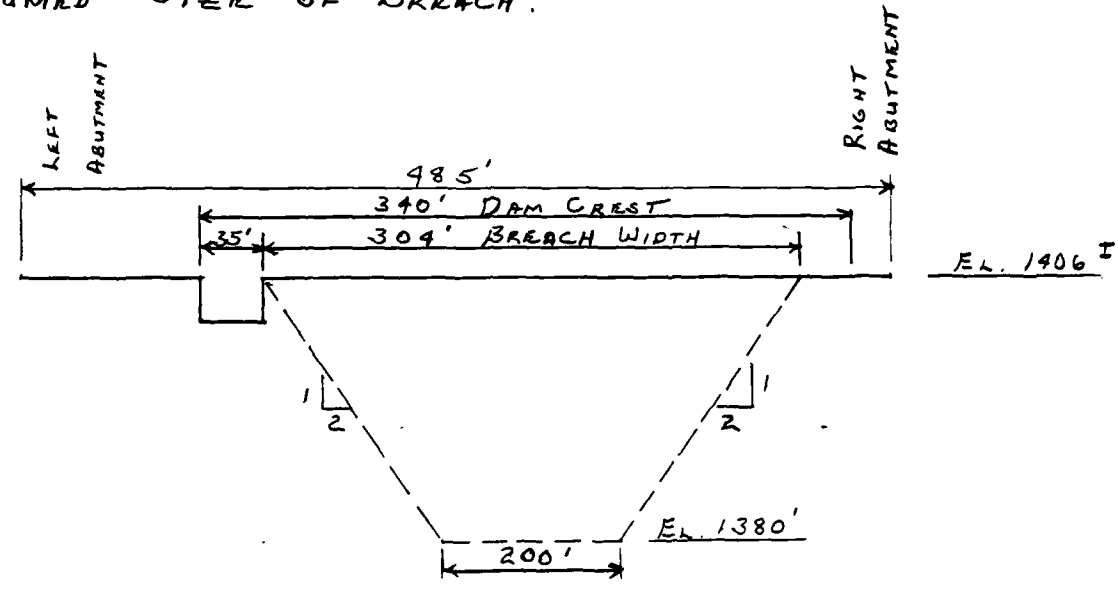
S = 0.0390

ESTIMATED 8' STREAM WIDTH

D'APPOLONIA
CONSULTING ENGINEERS, INC.

By MB Date 9/25/81 Subject LAKE SOPHIA Sheet No. 1 of 1
Chkd. By WTC Date 9/25/81 DAM BREACH Proj. No. 80-556-19

ASSUMED SIZE OF BREACH:

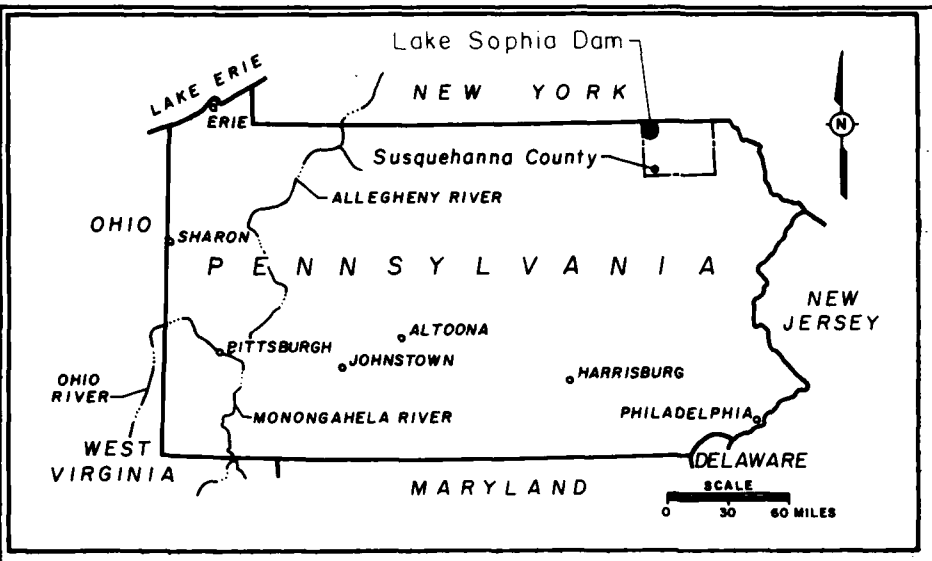



TIME OF BREACH 0.75 HOURS

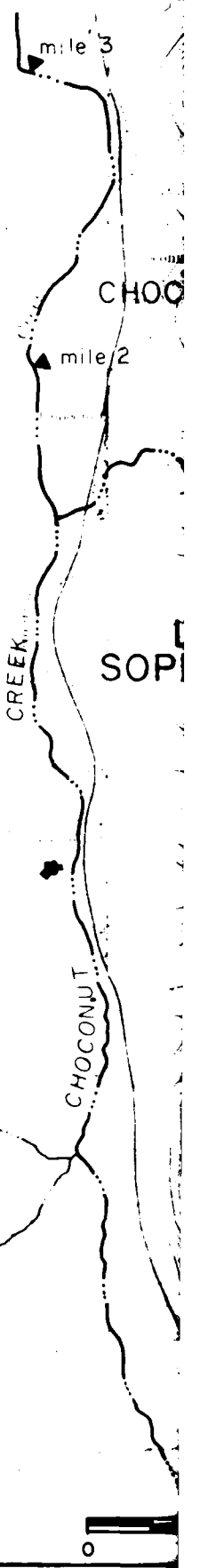
# APPENDIX E

# PLATES

| DRAWN BY | ACS | CHECKED BY | | DRAWING NUMBER 80-556-B19 |
|---|---|---|---|---|
| | 12-22-80 | APPROVED BY | 4/29/81 | |
| | | | 4-29-81 | |




KEY PLAN




C H O C O N U T

REFERENCES:

1. U.S.G.S. LAUREL LAKE, PA-NY QUADRANGLE PHOTOREVISED 1978, SCALE 1:24000
2. U.S.G.S. FRIENDSVILLE, PA-NY QUADRANGLE PHOTOREVISED 1978, SCALE 1:24000

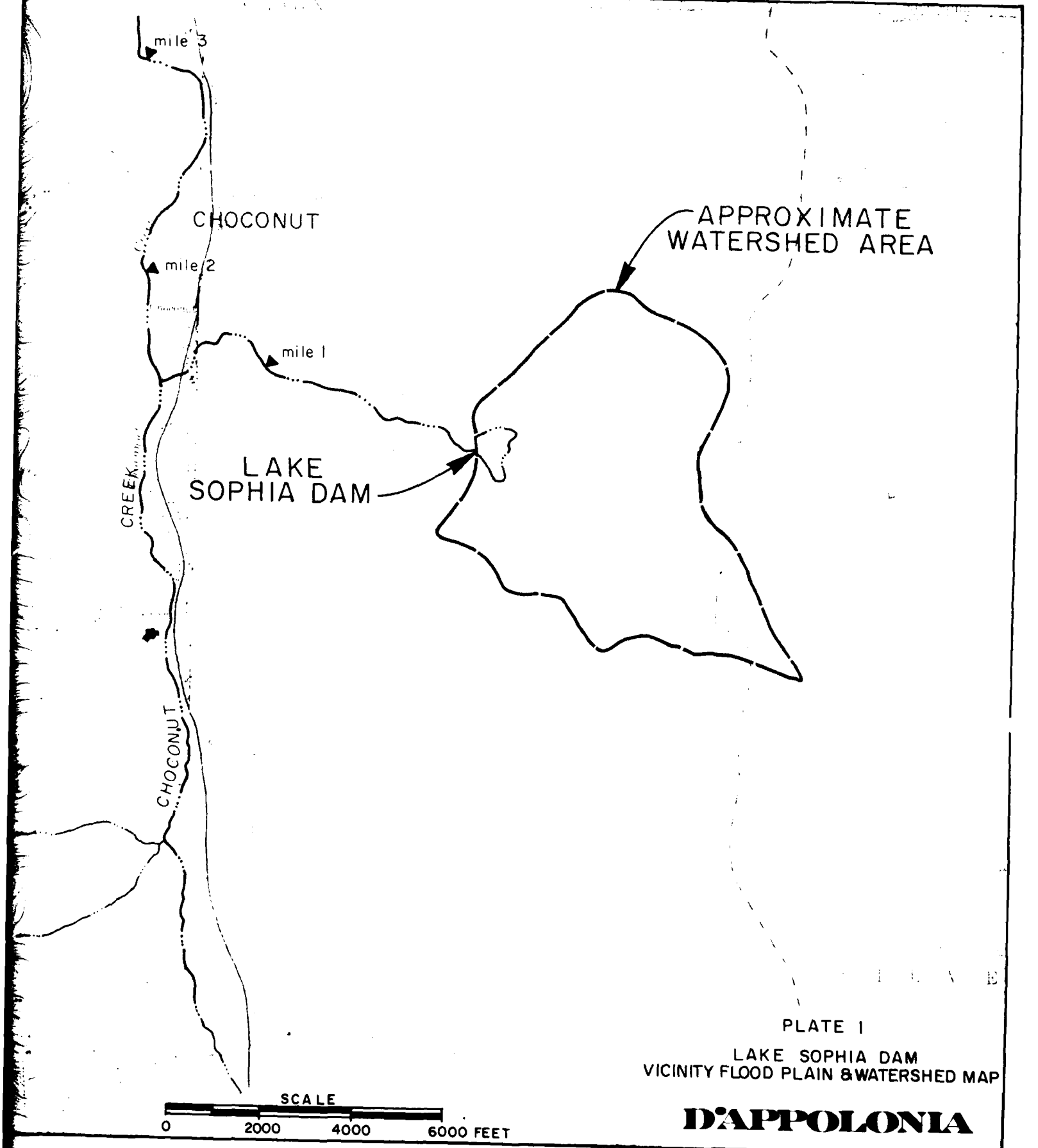
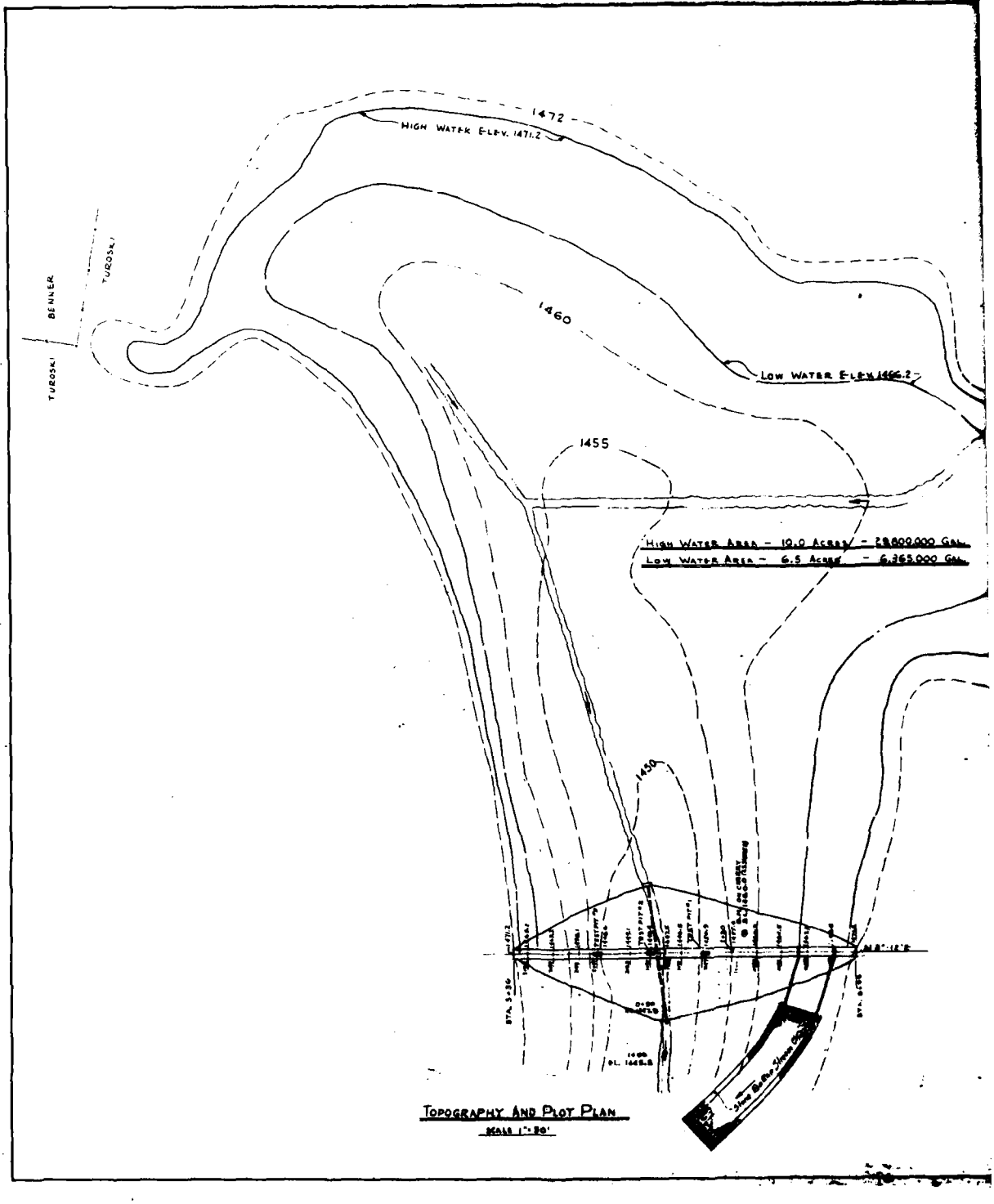



PLATE 1

LAKE SOPHIA DAM
VICINITY FLOOD PLAIN & WATERSHED MAP

D'APPOLONIA

| DRAWN BY | ACS | CHECKED BY | BC | DRAWING NUMBER | 80-556-B20 |
|---|---|---|---|---|---|
| | 4-28-81 | APPROVED BY | SHD | | 4-29-81 |




TOPOGRAPHY AND PLOT PLAN

SCALE 1" = 80'

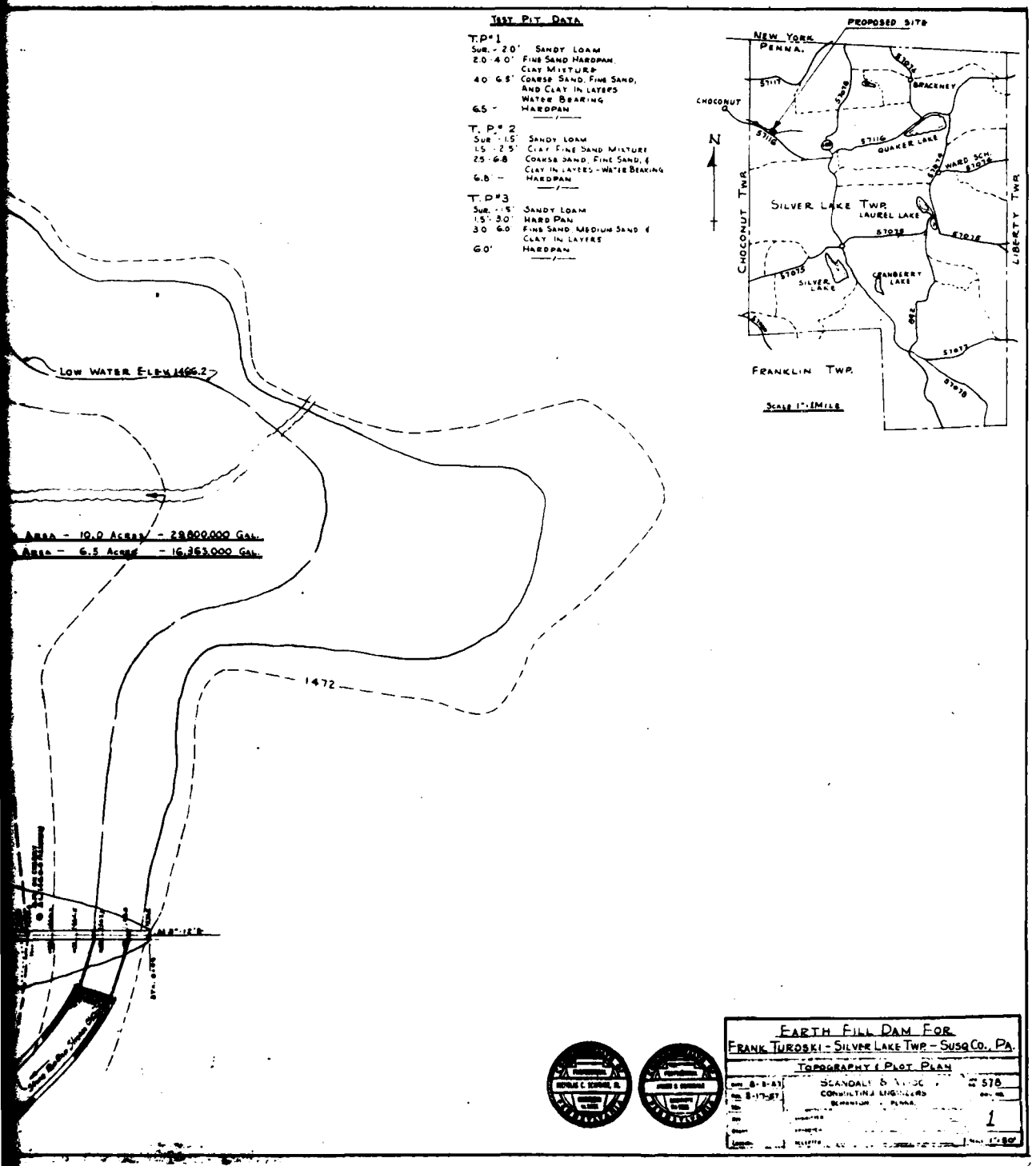



PLATE 2

D'APPOLONIA

. 2

| DRAWN BY | ACS | CHECKED BY | | DRAWING NUMBER 80-556-B21 |
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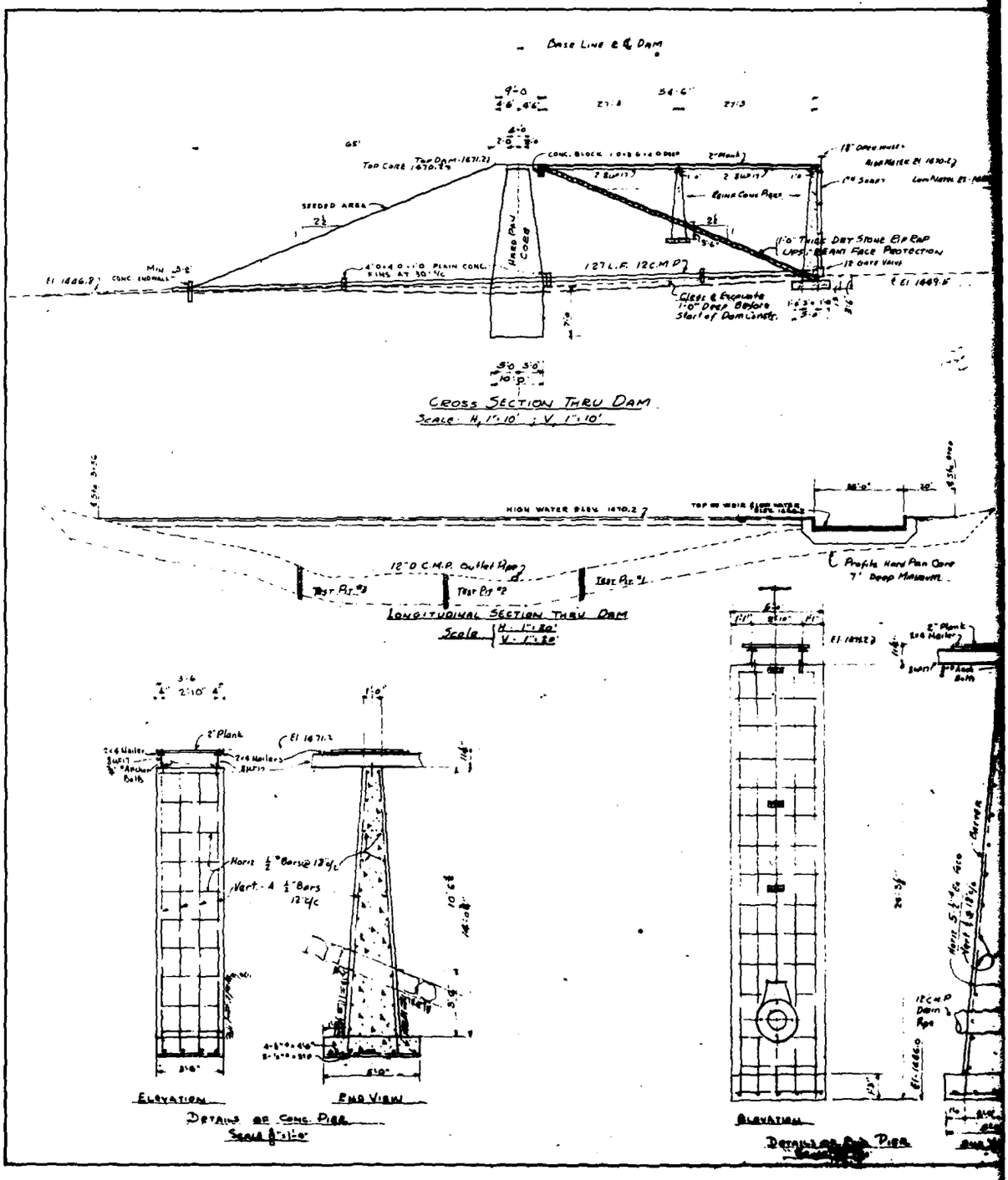

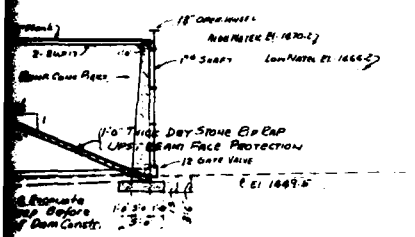


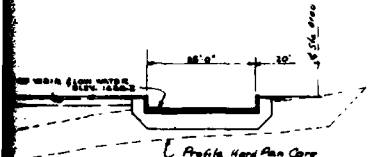


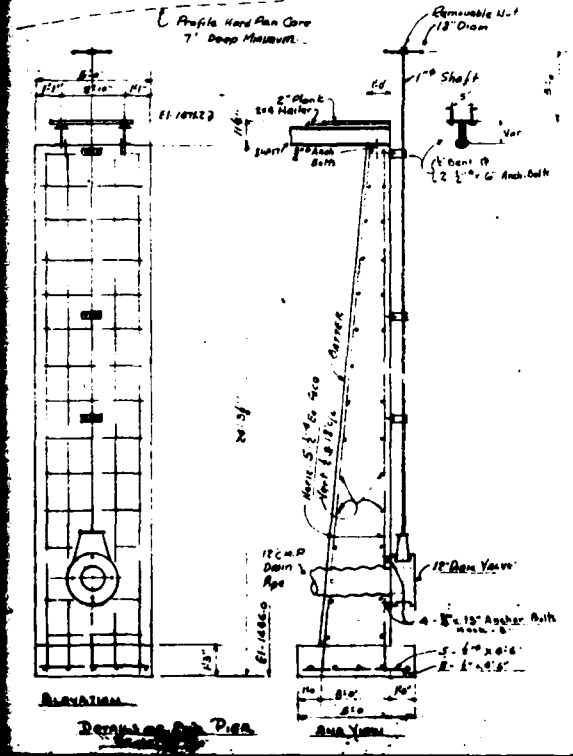


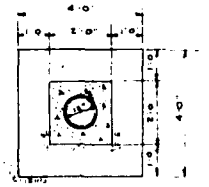


Section Showing Concrete Pipe Encasement & Fins

General Notes & Specifications

1. Clearing & Grubbing: The area to be occupied by the Dam shall be cleared & grubbed and all top soil removed to the depth shown.
2. The Fill with will placed in 8" layers and thoroughly compacted by means of either a three wheel, 10 ton Roller or a sheepsfoot Roller satisfactory to the Engineer.
3. The Hard pan Core will be constructed to Grade & Dimensions as shown.
4. The concrete spillway will be constructed to size & dimensions as shown. The fill shall be completed before excavation for the spillway, including the cut-off wall, is performed. The excavation shall be performed to neat lines & grades by means of hand tools, and all portions of the concrete in contact with earth shall be constructed without forms.
   Concrete shall conform to the following - f'c: 3300 psi at 28 days. All cement shall be Air-Entrained and the mix shall conform to the following tables -

| Cement Factor 94 lb. Sack per C.Y. of Conc | Max. water per 94 lb Sack of Cement | Max. Size of Coarse Aggr. | Wts. of Aggr. per 94 lb Sack of Cement: Sand | Coarse Aggr. |
|---|---|---|---|---|
| 6.5 | 5.7 | 1 inch | 200 lbs | 260 lbs |
| 6.2 | 5.7 | 1½ inch | 195 lbs | 300 lbs |
| 5.8 | 5.7 | 2 inch | 195 lbs | 365 lbs |

   All concrete shall be cured with saturated burlap for 3days. Concrete shall be protected from freezing by means of straw or other approved means.
5. The upstream face of the dam shall be protected by a dry stone Rip Rap. The stone shall have a maximum size of 18 inches and shall be hand placed. After the stone is placed, the interstices shall be filled with sand.
6. The downstream face shall be seeded and a 6 thick blanket of straw or hay shall be placed over all seeded portions.
7. Exposed edges of all concrete must be chamfered to 1".

| | | |
|---|---|---|
| Earth Fill Dam | | |
| For | | |
| Frank Turosel - Silver Lake Twp. - Susq. Co. - Penna. | | |
| Sections & Details | | |
| Date 8-2-57 | Scandalf & Assoc. Consulting Engineers Scranton - Penna. | No. 578 |
| | | 2 |

PLATE 3

D'APPOLONIA

| DRAWN BY | ACS | CHECKED BY | | 4/29/81 | DRAWING NUMBER 80-556-822 |
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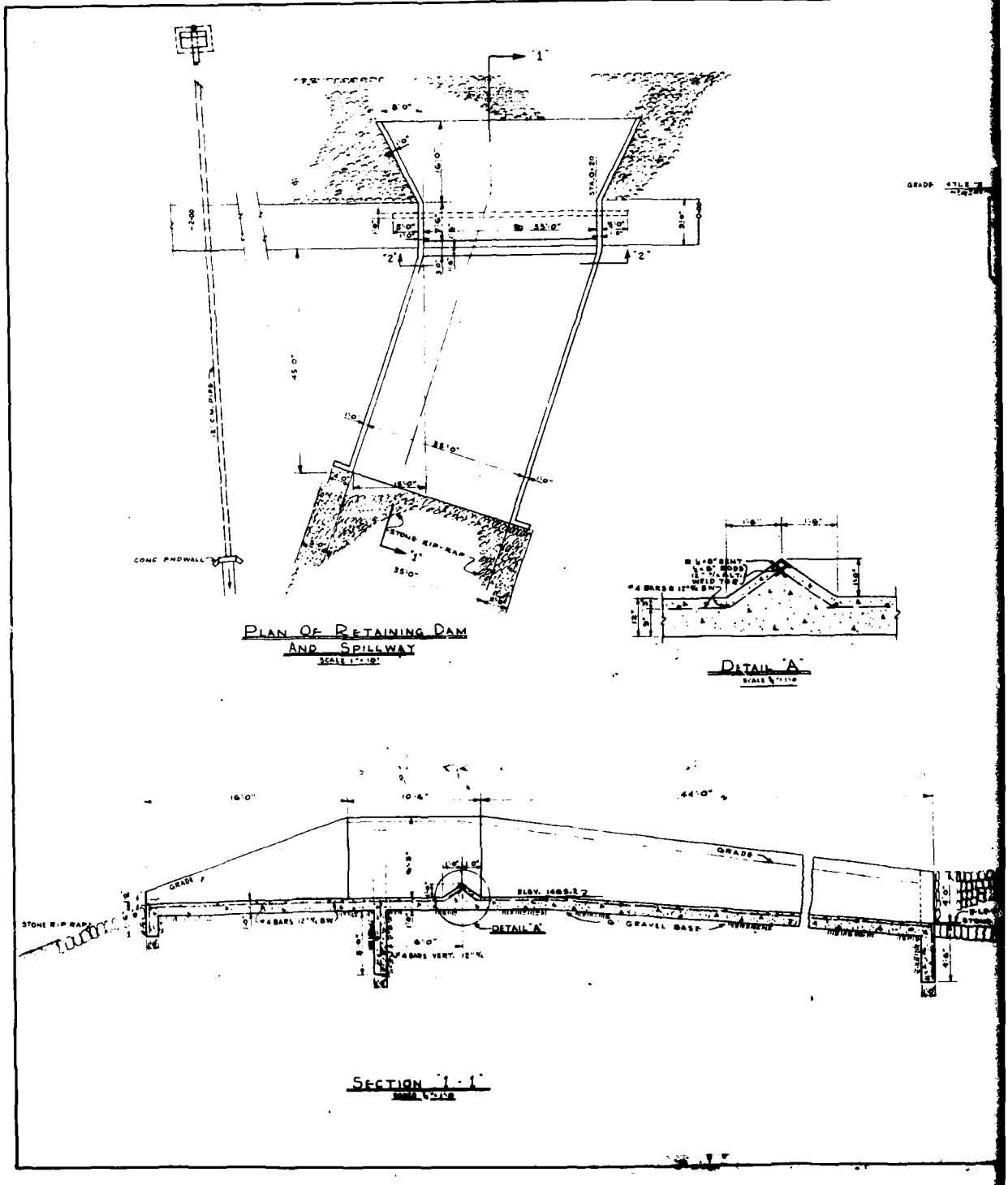
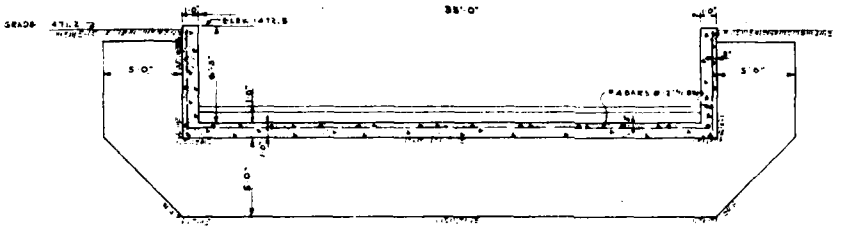
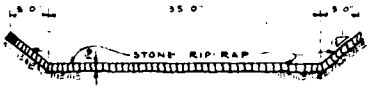
| | 4-28-81 | APPROVED BY | | 4-29-81 | |

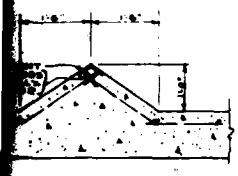




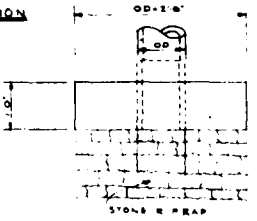
SECTION 2-2



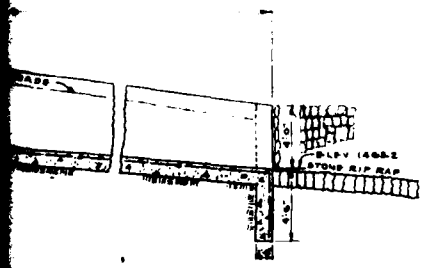

TYPICAL CHANNEL SECTION



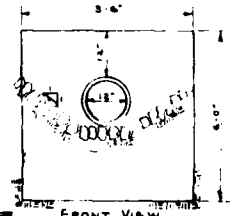
DETAIL "A"



TOP VIEW



PLAIN CONCRETE END WALL



FRONT VIEW

EARTH FILL DAM FOR
FRANK TURONSKI - SILVER LAKE TWP - SUSQ CO., PA

PLAN, SECTIONS & DETAILS

SCANDALE & ASSOC.
CONSULTING ENGINEERS

3

PLATE 4

D'APPOLONIA

12

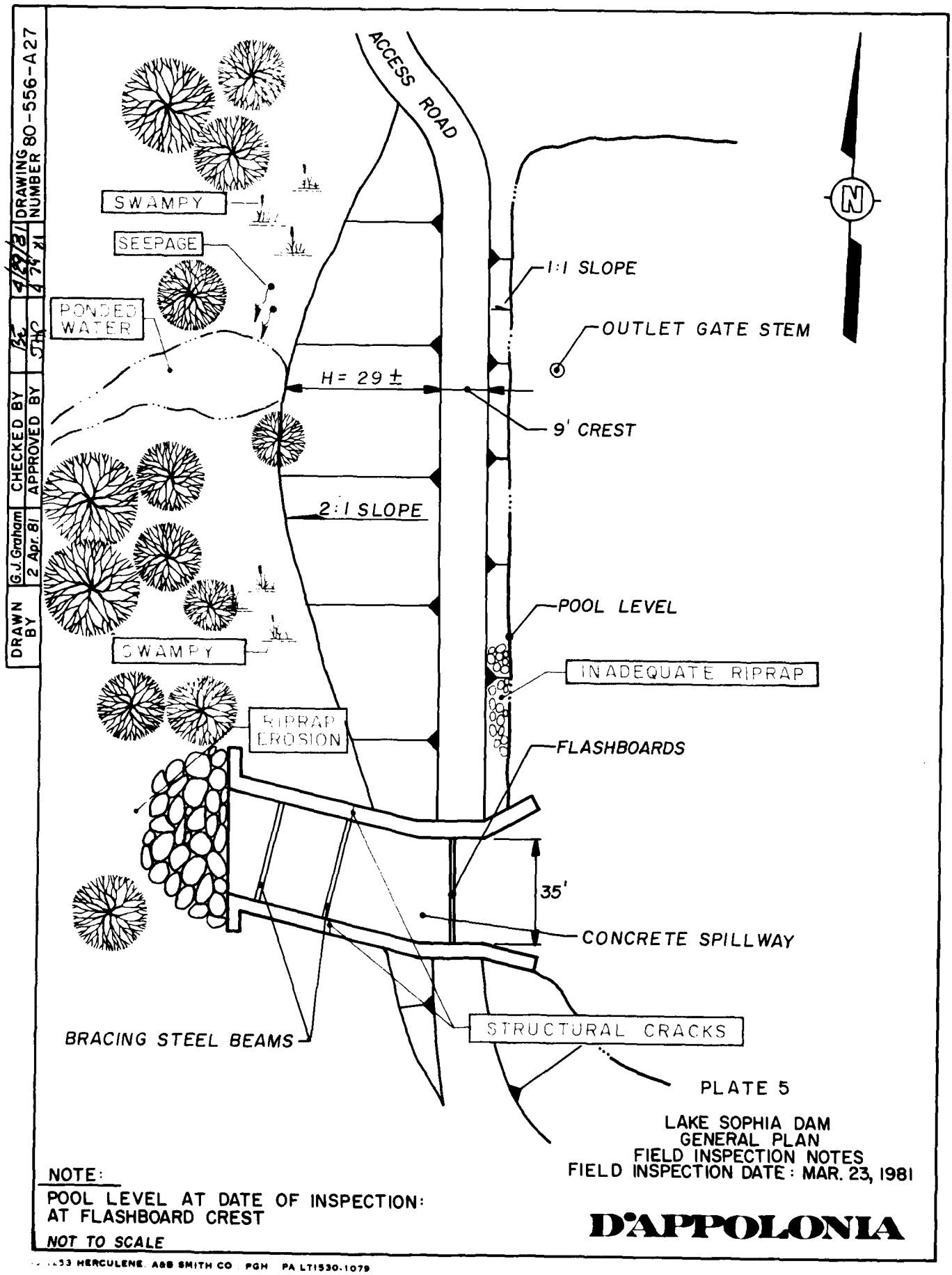



PLATE 5

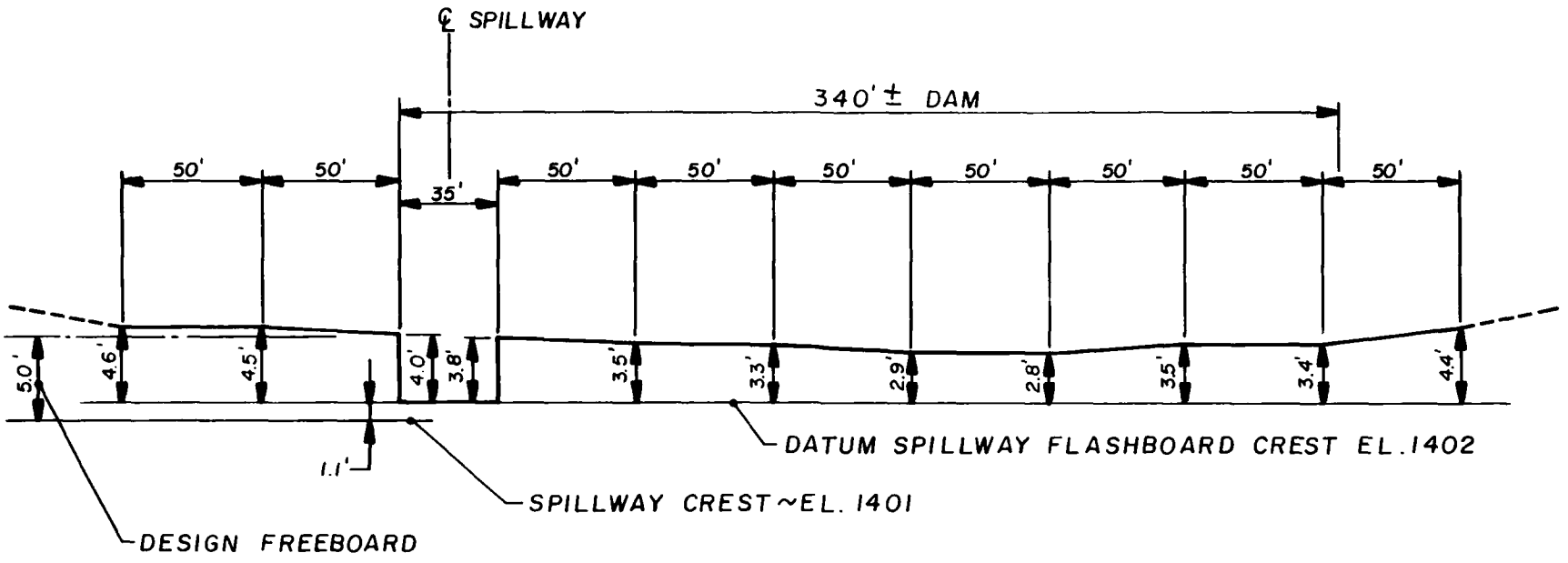
LAKE SOPHIA DAM
GENERAL PLAN
FIELD INSPECTION NOTES
FIELD INSPECTION DATE: MAR. 23, 1981

NOTE:
POOL LEVEL AT DATE OF INSPECTION:
AT FLASHBOARD CREST

NOT TO SCALE

D'APPOLONIA

| DRAWN BY | G.J. Graham | CHECKED BY | BE | 4/29/81 | DRAWING NUMBER 80-556-A28 |
|---|---|---|---|---|---|
| | 2 Apr. 81 | APPROVED BY | JHP | 4/29/81 | |




## DAM CREST PROFILE

(LOOKING DOWNSTREAM)

NOTES:

1. DAM CREST WAS SURVEYED RELATIVE TO SPILLWAY FLASHBOARD CREST LEVEL
2. DATUM ELEVATION WAS INTERPOLATED FROM U.S.G.S. MAP, THEREFORE IS APPROXIMATE.

PLATE 6

LAKE SOPHIA DAM
DAM CREST SURVEY
FIELD INSPECTION DATE: MAR. 23, 1981

D'APPOLONIA

# APPENDIX F

## REGIONAL GEOLOGY

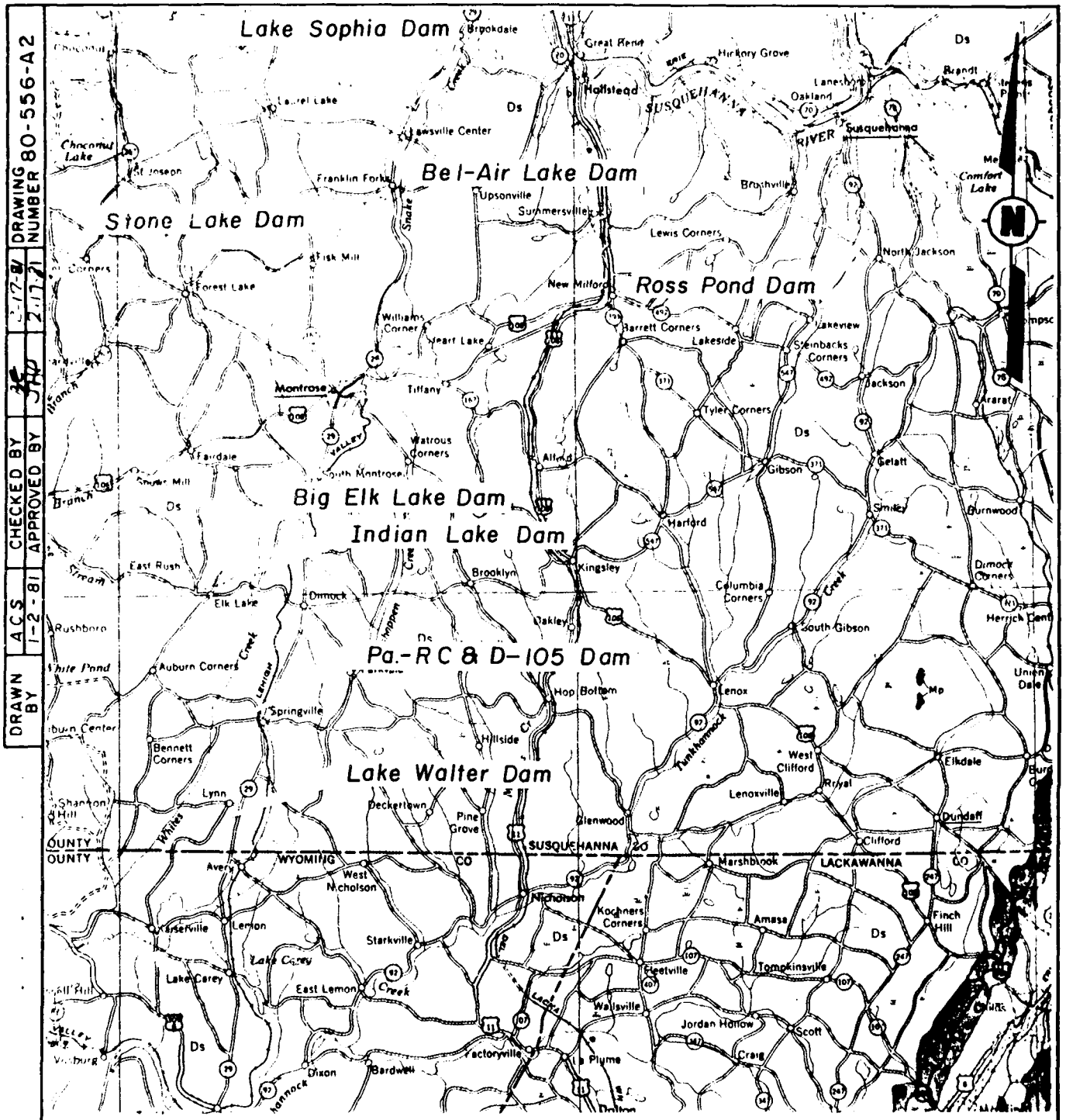
# REGIONAL GEOLOGY
# LAKE SOPHIA DAM

The Lake Sophia Dam is located in the glaciated low plateaus section of the Appalachian Plateau physiographic province, characterized as a mature glaciated plateau of moderate relief.

The geologic structure consists of a series of northeast trending folds (approximately N70°E) which plunge gently to the southwest. The dip of the limbs of the folds in the vicinity of the Lake Sophia Dam is less than two degrees, with the southeast limb slightly steeper than the northwest limb. The dam is located north of the Rome Anticline. In general, the discontinuity trends are northeast and northwest.

The stratigraphy consists of glacial till which will range in thickness from very thin to approximately 200 feet. The glacial till is underlain by the Devonian Catskill Formation, which is approximately 1,800 feet thick in this area. The Catskill Formation is continental in origin, consisting of red shale and cross-bedded red and green sandstone and siltstone. The shale strata tend to weather rapidly when exposed.

| DRAWN BY | DATE | CHECKED BY | DATE | APPROVED BY | DATE | DRAWING NUMBER |
|---|---|---|---|---|---|---|
| ACS | 1-2-81 | | | | | 80-556-A2 |




SCALE

0 2 4 6 8 10 miles

GEOLOGY MAP

REFERENCE

GEOLOGIC MAP OF PENNSYLVANIA PREPARED BY COMMONWEALTH OF PENNA, DEPARTMENT OF ENVIRONMENTAL RESOURCES, DATED · 1960
SCALE 1 · 250,000

D'APPOLONIA

| DRAWN BY | ACS | CHECKED BY | | 2-17-81 | DRAWING NUMBER 80-556-A4 |
|---|---|---|---|---|---|
| | 1-2-81 | APPROVED BY | | 2-17-81 | |

## PENNSYLVANIAN

### APPALACHIAN PLATEAU

**Allegheny Group** (Pa)
*Cyclic sequences of sandstone, shale, limestone and coal; numerous commercial coals, limestones thicken westward. Vanport Limestone in lower part of section, includes Freeport, Kittanning, and Clarion Formations.*

**Pottsville Group**
*Predominantly sandstones and conglomerates with thin shales and coals; some coals mineable locally.*

### ANTHRACITE REGION

**Post-Pottsville Formations** (Ppo)
*Brown or gray sandstones and shales with some conglomerate and numerous mineable coals.*

**Pottsville Group**
*Light gray to white, coarse grained sandstones and conglomerates with some mineable coal; includes Sharp Mountain, Schuylkill, and Tumbling Run Formations.*

## MISSISSIPPIAN

**Mauch Chunk Formation** (Mm)
*Red shales with brown to greenish gray flaggy sandstones; includes Greenbrier Limestone in Fayette, Westmoreland, and Somerset counties, Loyalhanna Limestone at the base in southwestern Pennsylvania.*

**Pocono Group**
*Predominantly gray, hard, massive, cross-bedded conglomerate and sandstone with some shale; includes in the Appalachian Plateau Burgoon, Shenango, Cuyahoga, Cussewago, Corry, and Knapp Formations; includes part of "Oswayo" of M. L. Fuller in Potter and Tioga counties.*

## DEVONIAN

### UPPER

### CENTRAL AND EASTERN PENNSYLVANIA

**Oswayo Formation**
*Brownish and greenish gray, fine and medium grained sandstones with some shales and scattered calcareous lenses; includes red shales which become more numerous eastward. Relation to type Oswayo not proved.*

**Catskill Formation** (Dck)
*Chiefly red to brownish shales and sandstones; includes gray and greenish sandstone tongues named Elk Mountain, Honesdale, Shohola, and Delaware River in the east.*

**Marine beds** (Dm)
*Gray to olive brown shales, graywackes, and sandstones; contains "Chemung" beds and "Portage" beds including Burket, Brallier, Harrell, and Trimmers Rock; Tully Limestone at base*

**Susquehanna Group** (Ds)
*Barbed line is "Chemung-Catskill" contact of Second Pennsylvania Survey County reports; barbs on "Chemung" side of line*

## GEOLOGY MAP LEGEND

REFERENCE:

GEOLOGIC MAP OF PENNSYLVANIA PREPARED BY COMMONWEALTH OF PENNA., DEPARTMENT OF ENVIRONMENTAL RESOURCES, DATED: 1960
SCALE 1:250,000

D'APPOLONIA

19 1293 HERCULENE. A&B SMITH CO., PGH., PA 17(530-1079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DATE
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